Nephrology in China

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Abstract | China has a large population and a high prevalence of chronic kidney disease (CKD). The increasing incidence of obesity and type 2 diabetes mellitus, coupled with an ageing population, will exacerbate the burden of CKD unless effective control and prevention strategies are implemented. The unmet challenges of managing the growing number of patients with end-stage renal disease (ESRD) in China are reflected by the lower rate of patients receiving dialysis relative to many Western countries, owing to a lack of financial and clinical resources, and inequalities in access to health care across regions and populations. The feasibility of expanding peritoneal dialysis is being examined, and ongoing health-care reforms provide an invaluable opportunity to improve the status and quality of dialysis for patients with ESRD in China. The Chinese Society of Nephrology (CSN) advocates for efforts focused on preventing CKD coupled with early detection, treatment, and adequate follow-up to reduce mortality and the long-term burden of CKD. In addition, rapid advances in nephrology research, from basic science to clinical epidemiology, as well as broad communication and collaboration between the CSN and other international nephrology societies, will promote the development of nephrology in China.

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Introduction

The Chinese Society of Nephrology (CSN) was founded in 1980 under the auspices of the Chinese Medical Association. By 2012, the CSN had grown to include more than 5,000 members. Provincial-level nephrology associations have also now been established in all provinces, autonomous regions, and municipalities. In the past decade, the endeavours of the Chinese government and nephrology societies have increased access to higher quality health-care systems and have improved patient care, medical education, and research in the field of nephrology.

Economic development, accelerated industrialization, urbanization, and behavioural and demographic changes in China have resulted in an increase in the incidence and associated mortality of chronic, non-communicable diseases. Such epidemiological transitions have been observed in many developed countries over the past 50 years and in China, have accelerated at an unprecedented pace and scale because of the rapid growth of the Chinese economy over the past 30 years.[1] Specifically, chronic kidney disease (CKD) imposes an enormous burden on public health resources. CKD also presents special challenges for China's ongoing health-care reforms, given the large numbers of patients requiring treatment, the imbalance in economic development across different regions, and health-care disparities in this large developing country. Although the burden of CKD in China represents an enormous challenge, it might also provide an opportunity to further progress nephrology in this country.

Competing interests
Z.-H. Liu declares an association with the Chinese Society of Nephrology.

Non-communicable diseases represent China's leading health problem. According to a 2011 collaborative report by the Chinese Ministry of Health and the WHO, these diseases are responsible for more than 80% of the country's 10.3 million annual deaths and nearly 70% of its total medical costs.[2] Unless effective control and prevention strategies are implemented, the increasing incidence of hypertension,[3] obesity[4] and type 2 diabetes mellitus[5] coupled with the ageing population[6] will exacerbate the burden of CKD in China.

In this Review, I discuss the prevalence and economic burden of kidney disease in China, as well as the current status of dialysis, acute kidney injury (AKI), kidney transplantation, and health-care reform. My aim is to improve awareness—and highlight the importance—of kidney disease in China.

The burden of chronic kidney disease

The number of patients with CKD in China is estimated to be approximately 119.5 million. A cross-sectional survey of a nationally representative sample of Chinese adults demonstrated that the prevalence of CKD varied widely among geographic regions, with an overall prevalence of 10.8%.[7] Although the estimated prevalence of CKD in China is similar to that reported for developed countries, such as the USA (13.0%)[8] and Norway (10.2%),[9] the aetiology differs to that of Western countries. Data from the Chinese Renal Data System, a national registry system for patients undergoing dialysis, revealed that glomerular disease was the most common cause of end-stage renal disease (ESRD; 57.4%), followed by diabetic nephropathy (16.4%), hypertension (10.5%), and cystic kidney disease (3.5%).[10] These rates

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Key points

- China has a high prevalence of chronic kidney disease (CKD); an increasing prevalence of hypertension, obesity and type 2 diabetes mellitus, and an ageing population will exacerbate the burden of CKD
- The current leading cause of CKD in China is glomerular disease, followed by diabetic nephropathy, and hypertension; IgA nephropathy is the most common glomerular disease
- The proportion of patients with end-stage renal disease receiving dialysis is low owing to a lack of financial and clinical resources and inequalities in health-care access
- The feasibility of expanding peritoneal dialysis, over more expensive haemodialysis, is currently has being examined
- Ongoing health-care reform in China will increase the prevalence of dialysis and improve long-term outcomes for patients with CKD
- The Chinese Society of Nephrology advocates for improved patient care, education and research; collaboration with international nephrology societies will promote the development of nephrology in China

are different from those reported for developed countries, such as the USA[11] and the UK[12] where the major cause of ESRD is diabetic nephropathy (Figure 1). However, a shift in the epidemiology of kidney disease has been reported in China. The leading causes of CKD among elderly Chinese patients are diabetes mellitus and hypertension, rather than glomerular disease.[13] Moreover, it is possible that the prevalence of diabetic nephropathy in China will continue to rise, given the rapid increase in the prevalence of diabetes mellitus in the country.[5] Indeed, diabetic nephropathy now accounts for 46.2%[14] and 43.2%[15] of ESRD cases in the more developed regions of Hong Kong and Taiwan, respectively.

Renal biopsies are performed routinely in the nephrology units of most large hospitals in China and have provided histological evidence to support the epidemiologic data. According to these data, primary glomerulonephritis was identified in 61.7–68.6% of renal biopsy samples. IgA nephropathy constituted about 45.3–54.3% of cases of primary glomerulonephritis; other causes were mesangial proliferative glomerulonephritis (11.1–25.6%), membranous nephropathy (9.9–15.0%), minimal change disease (10.9%), and focal segmental glomerulosclerosis (7.75%).[16,17] These data also indicated that the spectrum of primary glomerulonephritis has changed over the past 15 years. The relative frequency of mesangial proliferative glomerulonephritis has decreased significantly, whereas that of minimal change disease and IgA nephropathy has substantially increased. The frequency of focal segmental glomerulosclerosis increased markedly in younger patients.[16]

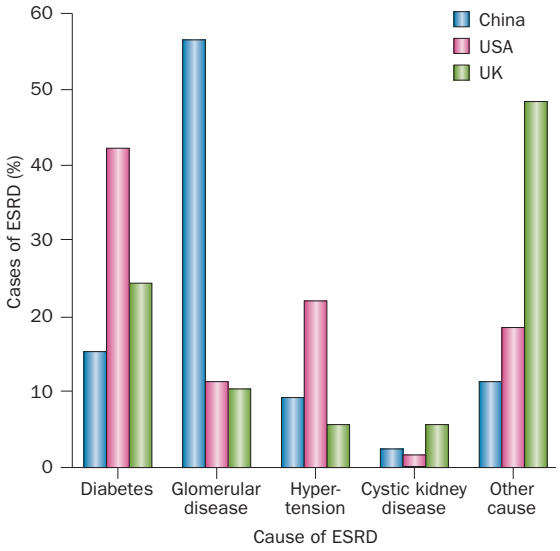

Figure 1 | Different causes of ESRD in China, the USA and the UK. Abbreviation: ESRD, end-stage renal disease.

The current status of dialysis

Use of renal replacement therapy (RRT) in patients with ESRD is a public health challenge that puts a large economic burden on individuals and on health-care resources. The unmet challenges of ESRD therapy are reflected by the lower prevalence of dialysis in China relative to many other developed countries owing to a lack of financial and clinical resources available for Chinese patients with ESRD.[18] A survey by the Chinese Society of Blood Purification estimated that the point prevalence of patients with ESRD on maintenance haemodialysis or peritoneal dialysis was 71.9 per million population (PMP) in mainland China in 2008, with an annual increase in the prevalence of 52.9%.[19] In Taiwan, the prevalence of patients with ESRD on dialysis reached 2,584 PMP in 2010, whereas rates of 1,106 PMP and 1,870 PMP were reported in Hong Kong and the USA, respectively.[20] The lower rate of dialysis in China largely stems from unaffordable health care, major financial risks associated with out-of-pocket medical expenses, and growing inequalities in access to health care and in health status across populations with different socioeconomic statuses and across urban and rural regions. These issues are now being tackled under the new Chinese health reform strategy. The Chinese government aims to expand health insurance to cover more chronic and major diseases identified as a priority, and to reduce the financial burden for individual patients. Local Civil Affairs Bureaus can design their medical assistance programmes to cover any remaining co-payment for low-income households. Fortunately for nephrology programmes, the central government included ESRD on the list of major diseases in 2012, providing an important policy guarantee and resources to promote the prevalence and quality of dialysis in China.

A survey of patients on maintenance haemodialysis in Beijing reported that the raw annual mortality of the cohort increased from 47.8 per 1,000 patient-years in 2007 to 76.8 per 1,000 patient-years in 2010.[21] Data from the US Renal Data System reported the raw annual mortality for white individuals on haemodialysis to be 250.7 per 1,000 patient-years in 2007, decreasing to 236.3 per 1,000 patient-years in 2009.[22] The mortality of patients on haemodialysis in China was, therefore, relatively low compared with the USA. The main causes of death for patients on haemodialysis in China were cardiovascular (31.0%), stroke (20.3%), infection (19.9%) and other causes (28.8%).[19] No large cohort study on dialysis outcomes in Chinese populations has been published.

However, 45 dialysis centres from Beijing, Shanghai and Guangzhou, have joined the Dialysis Outcomes and Practice Patterns Study (DOPPS4, 2009-2011) since 2010, and intend to evaluate practice patterns and outcomes of patients on haemodialysis in China within an international context. Data from DOPPS4 have confirmed that the major cause of ESRD in Chinese patients is glomerulonephritis (46.5%). Similarly, the major cause of ESRD in Japan is glomerulonephritis (44.8%), whereas in the USA the major cause is diabetic nephropathy (43.2%). The average age of patients with ESRD in China was 59.0 years, which was younger than in the USA (62.8 years) and Japan (64.7 years). The proportion of patients who underwent maintenance haemodialysis for more than 4 years was 40.0% in China, 29.9% in the USA and 64.2% in Japan. The proportion of patients with serum albumin levels ≥40 g/l was higher in China (50.4%), than in the USA (39.1%) or Japan (28.7%). The average Kt/V was 1.37 ± 0.32 in China, 1.42 ± 0.26 in Japan and 1.59 ± 0.27 in North America (L. Zuo, unpublished data).

According to data from the Chinese Renal Data System,[23] the number of patients undergoing haemodialysis at the end of 2012 was 270,000, compared with just 30,000 receiving peritoneal dialysis, indicating that 90% of patients with ESRD and receiving RRT in China received haemodialysis. As the prevalence of ESRD is increasing rapidly, it will be important to evaluate the role of peritoneal dialysis as a treatment option in China. Peritoneal dialysis might have advantages over haemodialysis, including its simplicity and minimal requirements for technical support and electricity. For example, patients living in remote and rural locations could use peritoneal dialysis as a home-based treatment option. In China, the annual cost of peritoneal dialysis is approximately US$15,034, whereas the cost of in-centre haemodialysis is US$16,625 (home haemodialysis is very rare and no information regarding the cost of this modality in China is available).[24] A thorough assessment of alternative RRT modalities, such as home peritoneal dialysis, could address some of the challenges currently faced by the Chinese nephrology community, including access to RRT (particularly in remote regions).

The reasons for limited access to peritoneal dialysis in China include geographical variations, which result in differences in socioeconomic status, and access to health care between rural and urban areas, and a lack of training, education, and quality control systems in most parts of the country. Although peritoneal dialysis is less expensive than haemodialysis, it remains unaffordable for most patients. To facilitate the expansion of peritoneal dialysis, the Chinese government is planning to adjust reimbursement policies, introduce new insurance systems (especially in rural areas), and support the local manufacturing of peritoneal dialysis solutions. Currently, 90% of peritoneal dialysis solutions used in China are imported, and international trade agreements are being promoted to reduce costs. The Chinese Ministry of Health has now certified 31 training centres across the country to promote the implementation of peritoneal dialysis in both developing urban and rural areas. These centres are responsible for establishing regional satellite centres to build basic services, involving staff training, patient education, the development of standardized protocols, and the implementation of quality assurance protocols. The ultimate goal is to establish a dialysis network in China. To address the uncertainties regarding future models of peritoneal dialysis in China, further efforts are needed from the government, nephrology societies, academic centres, and social resources such as industry affiliates.

The shortage of nephrology specialists remains another challenge for the management of patients with CKD in China. A nationwide survey indicated that only 8,000 doctors were registered as nephrologists in 2008, which is equivalent to one nephrologist per 15,000 patients with CKD.[7,25] The medical education system in China must be reformed to produce well-trained primary health-care providers, but this will take time given the country's vast need. The Chinese government is now considering tasking workers, such as nurses, community health workers, or village doctors to fill the workforce gaps, especially in low-income areas.[26]

Acute Kidney Injury

AKI is increasingly prevalent in developing and developed countries and is associated with severe morbidity and mortality.[27] Little data are available regarding the incidence of AKI in China. Single-centre studies have shown that AKI complicates 2.41–3.38% of all hospital admissions, with an associated mortality rate of 18.57–28.2% in those affected.[28–30] In the elderly, the incidence of AKI is reported to be >14%, with hypovolaemia, nephrotoxic drugs, cardiac dysfunction and respiratory failure the most common aetiologies.[31,32] In a study of 1,056 patients who underwent cardiac surgery, AKI was reported in 31.1%, with a total hospital mortality rate of 36.5%.[33] The incidence of AKI was reported as 32.2% in patients with acute heart failure[34] and 34.1% in critically ill patients.[35]

Drug-induced kidney injury is becoming a major cause of AKI in China. Based on an AKI registry originating from 17 hospitals in Shanghai, drug-induced AKI accounted for 28.9% of 1,200 cases.[36] Antibiotics were the leading cause of drug-induced AKI (47.8%), followed by diuretics (22.2%) and radiocontrast agents (13.3%).[36] About one-third of the affected patients needed RRT. The in-hospital mortality was 28.8%, and only 54.2% of the surviving patients completely recovered their renal function.[36] In a single centre study involving 1,440 patients with AKI, drug-induced AKI was the most common aetiology.[37] An improved awareness of the renal toxicity profile of various drugs, the rational use of medications, and strict monitoring of patients who are prescribed potentially nephrotoxic drugs is essential to prevent drug-induced AKI.

The RIFLE (Risk, Injury, Failure, Loss, and End-stage renal disease) and Acute Kidney Injury Network (AKIN)[38,39] classification systems, as well as the KDIGO (Kidney Disease: Improving Global Outcomes) Clinical

Practice Guideline for AKI, have been introduced in China.[40] All of these classification systems and guidelines need to be fully evaluated in clinical practice in China.

Kidney transplantation

The kidney transplantation programme began in China in the 1960s.[41] Data from the Chinese Scientific Registry of Kidney Transplantation shows that more than 60,000 kidney transplantations have been performed since 1977, with ~5,000–6,000 performed each year throughout the country during the past 5 years.[42] The 1-year and 10-year graft survival rates are >90% and >70%, respectively. The Chinese government strictly follows the Declaration of Istanbul and the guiding principles of the WHO for organ transplantation and prohibits organ trade. The system of organ transplantation, including the national human organ donor registry, organ donation and distribution network, and medical services for organ transplantation are going to improve.[43,44] In China, organ transplantation is a different speciality to nephrology and is overseen by The Chinese Society of Organ Transplantation.

Health-care reform

In 2009, the Chinese government announced an ambitious health-care reform plan and committed to spending an additional CN¥850 billion (about US$125 billion) over the following 3 years to provide affordable and equitable basic universal health care by 2020.[45] Between 2009 and 2011, the reforms focused on five different areas: expanding insurance coverage to more than 90% of the population; establishing a national essential medicine system to meet all primary medical needs; improving primary care delivery to provide basic health care and to manage referrals to specialist care and hospitals; making public health services available and equal for all; and piloting public hospital reforms.[46] Reforming public hospitals requires a number of measures such as clearly stating the roles and functions of such entities and shifting to a model of market competition and private ownership of public hospitals. Furthermore, reforms must reorganize the responsibilities and powers of individual city and governmental departments, and decrease the decision-making power of individual public hospitals.[46]

The medical insurance system in China includes three programmes: the urban employee basic medical insurance, which covers formal sector urban workers; the urban resident basic medical insurance, covering children, students and elderly people without previous employment; and the New Cooperative Medical Scheme (NCMS) for residents in rural locations.[47] By 2011, more than 1.3 billion people had joined the three basic medical insurance schemes; total coverage increased from 87% in 2008 to 95% in 2011.[47] As CKD was defined as a major chronic disease by the Chinese government, all three basic medical insurance systems cover both haemodialysis and peritoneal dialysis, but the reimbursement rates vary from 50% to 90% across regions with different socioeconomic statuses. Unfortunately, no data regarding specific regions at either end of this spectrum are available. Providing medical insurance to 1.3 billion people is a major challenge, and although coverage was fairly limited initially, the accomplishment of near universal insurance coverage since the establishment of NCMS in 2003 is quite remarkable. For example, when NCMS was first established, the standard subsidy rate was ¥2 per person per year. This rate had increased to ¥240 in 2012 and will continue to increase to ¥360 by 2015.[48] To further ameliorate health-care disparities between areas in China, the government has encouraged community-based care and the development of Community Health Centres, as well as the training of general practitioners and the introduction of new medical insurance systems, especially in rural areas. These innovations are radically reforming the Chinese health-care system and provide an invaluable opportunity to increase the prevalence of dialysis and improve long-term outcomes for patients with ESRD. Some issues are unique to China, but many other problems and lessons are relevant elsewhere, especially in developing countries.

Conclusions

The total population of China is more than 1.3 billion, and its renal disease health-care system is possibly the largest in the world. The CSN advocates that efforts focused on preventing CKD should be coupled with early detection, treatment, and adequate follow-up to reduce mortality and the long-term burden of the disease. In 2006, the CSN actively participated in the annual World Kidney Day event organized by the International Society of Nephrology and the International Federation of Kidney Foundations to alert the public to kidney diseases and to draw attention to the national health strategy aimed at reducing the growing burden of CKD and its consequences.

Although the prevalence rates of diabetes mellitus and hypertension are increasing dramatically, glomerular disease remains the leading cause of ESRD in China. The current status of glomerulonephritis management in China relies mostly on empirical data, and few randomized controlled trials (RCTs) have been conducted. To improve patient care and help clinicians understand evidence-based practice, experts from China have participated in KDIGO's efforts to develop clinical practice guidelines in the field of kidney diseases. As part of its education programme, the CSN promotes the KDIGO and Kidney Disease Outcomes Quality Initiative guidelines at the society's annual congress and regional continuing medical education courses. CSN hosted the 2012 implementation conferences for the KDIGO clinical practice guidelines in China. In fact, the evidence described in these guidelines included a few RCTs from China. However, these studies were fairly weak, highlighting the need for a larger number of high-quality multicentre RCTs to evaluate the evidence and support regional guideline development. In addition, some Chinese renal centres are involved in international multicentre studies, including the Aspreva Lupus Management

Study (ALMS)[49,50] the Oxford classification of IgA nephropathy[51,52] and its evaluation study,[53] and the Study of Heart and Renal Protection (SHARP).[54] These experiences provide opportunities to assist in new efforts for international evidence-based guidelines.

In the past decade, the development of nephrology in China has been boosted by rapid progress in cutting-edge research covering the entire spectrum of renal medicine, from basic science to clinical epidemiological studies. Accompanying the development of science and technology in China, research grants for biomedicine from the central government have increased considerably. For example, the total funding for biomedicine from the National Natural Science Foundation of China was ¥0.35 billion in 2001,[55] increasing to ¥7.21 billion by 2012.[56] Nephrology investigators have received support from national science programmes, such as the National Basic Research Program of China, and the number of publications from Chinese institutions related to kidney diseases has increased tremendously during the last decade—from 23 in 2002 to 245 in 2012.[57,58] In China, the body of published work is continuing to increase, and will provide a major contribution to new knowledge in the field of nephrology worldwide.

Review criteria

PubMed and Medline were searched for English-language articles, and the China National Knowledge Infrastructure databases were searched for Chinese-language articles, published between 2000 and 2012 using the following terms, "nephrology", "nephropathy", "chronic kidney disease", "dialysis", "glomerulonephritis", "end-stage renal disease", "acute kidney injury", "renal transplantation", "health-care reform" and "China". Additional references were obtained from the identified papers. Nephrologists from renal centres throughout China were consulted to ensure a comprehensive list of publications on the advancement of nephrology in China.

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