REVIEW ARTICLE

# Peritoneal dialysis and its role in the demography and epidemiology of chronic kidney disease

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**KEY WORDS**

chronic kidney disease, demography, epidemiology, peritoneal dialysis

**ABSTRACT**

In a population of patients who have undergone renal replacement therapy, the 21st century brought a rise in the number of elderly people as well as patients with obesity, with renal complications of systemic diseases, especially diabetes and hypertension, and a constantly increasing number of patients with congestive heart failure who require intermittent or permanent dialysis support. In keeping with the concept of an integrated approach to renal replacement therapy, peritoneal dialysis should be the first option in renal replacement treatment, especially in patients with residual renal function. This paper summarizes the current evidence supporting the view that the changing demography and epidemiology of chronic kidney disease imposes an introduction of patient-friendly modifications of therapeutic options available in these patient groups.

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**Introduction** According to the 2002 National Kidney Foundation Disease Outcomes Quality Initiative classification, chronic kidney disease (CKD) is morphological or functional damage to the kidneys lasting 3 months or longer with normal or decreased glomerular filtration rate (GFR), or every decrease in GFR below 60 ml/min/1.73 $m^2$ lasting longer than 3 months, with or without renal injury.[1] According to this classification, peritoneal dialysis (PD) is a method of renal replacement therapy that is indicated when GFR drops below 15 ml/min/1.73 $m^2$. After actively participating for 45 years in the implementation and modification of various forms of PD in Poland, I am concerned by the fact that PD has recently been superseded by hemodialysis (HD) in renal replacement therapy.[2-4] This is especially disturbing given new patient groups suitable for PD that emerge due to the changing demography and epidemiology of CKD.[5] These include patients at an advanced age, those without vascular access to HD, and patients with organ complications of diabetes or hypertension.[4] There is a steady increase in the number of patients with a primarily nonrenal cause of GFR reduction, as is the case, for example, in congestive heart failure (CHF) resistant to pharmacological treatment.[6] Therefore, the question that arises is whether, and to what extent, the rapidly changing demography and epidemiology of CKD may influence the range of PD application, thus imposing an introduction of more patient-friendly modifications to therapeutic methods.

**Peritoneal dialysis and demography of chronic kidney disease** The rise in the number of patients at an advanced age (aged ≥65 years) and those with obesity is particularly significant for CKD management. Currently, life expectancy is above 65 years of age, but in many developed countries it is considered to be between 75 and 80 years of age. The 21st century will see even faster population aging. By the year 2050, the number of elderly people will exceed 2 billion, and for the first time in history the number of elderly people will be higher than the number of children.[7] Currently, the population of people aged 65 years and older constitutes 40% to 50% of hospitalized patients, and 30% to 55% of patients treated with renal replacement therapy. The percentage of patients at an advanced age who undergo PD in Europe is as follows: 21% in Great Britain, and 10% in the Netherlands.[8,9] In France, PD is chosen by 34% of men and 59% of women over the age of 75.[10] According to the Rutkowski's report (December 31, 2006), in Poland 44.4% of patients aged above 65 years underwent dialysis (PD + HD). Moreover, the age distribution in patients who underwent

PD in Poland between 2001 and 2006 demonstrated a clear shift in 2006 towards predominance of elderly patients.[4]

CKD in elderly patients displays several differences as compared to patients at a younger age.[11] These are:

**1** primary/secondary atherothrombotic disease (more frequently), obstructive uropathy, type 2 diabetic nephropathy, hypertensive nephropathy, vasculitis, multiple myeloma

**2** symptoms of uremia are generally less severe than those of decompensated primary disease and/or comorbidities

**3** indications for dialysis therapy occur at a lower plasma creatinine concentration, especially in malnourished patients.

Balogun et al. used the data obtained from 322,000 patients in the 5th stage of CKD and at the start of renal replacement therapy to examine associations between creatinine concentration values in blood plasma and clearance of endogenous creatinine, depending on the patient age. Elderly patients, especially those over 75 years of age, were characterized by lower creatinine concentrations, with a greater GFR reduction compared with those aged 20 to 44 years (6.88 mg/dl and 11.6 ml/min vs. 10.7 mg/dl and 14.8 ml/min, respectively). This led to more frequent delay of renal replacement therapy, especially in patients over the age of 75.[12]

The advantages of PD as a method of renal replacement therapy are as follows:

**1** absence of hemodynamic stress, better treatment for arrhythmia than in HD (due to the continuous nature of dialysis)

**2** good control of anemia

**3** longer preservation of residual renal function than in HD

**4** dialysis in home conditions

**5** less strict dietary requirements.

Incorporation of PD in elderly patients is fully justified when the following conditions are met:

**1** strong clinical and biochemical indications for dialysis

**2** PD would ensure greater comfort of life

**3** the patient's biological age is significantly lower than the chronological age

**4** limited number and severity of risk factors and cardiovascular complications of CKD.

The decision whether to incorporate renal replacement therapy in elderly patients or not is often difficult. Mallick and El Marasi addressed this issue in their paper entitled "Dialysis in the elderly: to treat or not to treat".[13] They distinguished between patients who are able to handle independent dialysis ("fit elderly") and those unable to do so ("frail elderly"). The first group was able to function independently and retained their motor abilities. The second group was characterized by a constant need for medication, numerous comorbidities, and mental deficits, which did not allow them to perform PD on their own. Patients who are not prepared for an independent dialysis program may consider PD to be an additional burden or may reject it, if it is not presented in an appropriate manner. If patients find out about their disease for the first time in hospital after symptoms of uremic syndrome has occurred, they may react negatively, deny the existence of the disease, and reject therapy. As a result, they do not incorporate the information provided during PD education program and do not acquire practical skills necessary to perform an independent dialysis.[3,11]

However, old age, including the age over 80 years, should not limit access to dialysis therapy. The results of studies conducted by Lamping et al. from Great Britain and Couchoud et al. from France[14,15] corroborated this fact. A prospective study on 221 patients aged over 70 years, who had undergone HD or PD in 4 British centers (North Thames Dialysis Study), demonstrated that mortality significantly correlated with old age in patients over the age of 80, whereas it showed no correlation with diabetes, ischemic heart disease, cerebrovascular disease, gender, and the form of dialysis therapy.[14] In a study by Couchoud et al. (French Rein Registry) on a group of 3512 patients aged 75 years or older, the 24-month patient and dialysis method survival were assessed, showing a similar patient survival rate in both methods. PD was significantly more often chosen by patients over the age of 85, patients with CHF, and those with mental disorders, and less often by obese patients.[15]

In an answer to an increasing number of elderly patients who qualify for renal replacement therapy, forms of home support have been developed, such as home assisted PD and supported PD.[3,16] Home assisted PD is performed by the nursing personnel from the PD station closest to the patient's home. Elderly, disabled, single (with no assistance at home), and visually handicapped (mainly due to diabetes) patients qualify for this form of therapy. Supported PD is emergency aid in case patients had difficulty in conducting PD on their own or in the event of complications. Both programs have been successfully conducted in western European countries for many years, due to financial and logistic support from appropriate institutions. We introduced supported PD in our center in 2007. Unfortunately, widespread implementation of both PD forms in Poland is limited due to a number of financial and economic reasons.[17]

**Peritoneal dialysis and obesity** Over the last 20 years, there has been an increase in the number of obese people in the world, from 200 million in 1990 to 300 million in 2005, with excess weight or obesity affecting 50% to 75% of women, and 50% of men. In Europe, 40% of the general population is obese, while every fifth woman and every fourth man are obese in Poland.[18]

In the population of patients with CKD, a 2-fold increase in the percentage of obese patients has been observed.[19] The recognized factors of CKD progression are morbid obesity (body mass index

[BMI] >35 kg/m$^2$), obesity in patients who have undergone unilateral nephrectomy, obesity in patients who have had kidney transplant, and obesity in the course of certain glomerulopathies (IgA nephropathy, focal glomerulosclerosis). There are no available data regarding this issue in Polish patients.

The effect of body mass at the start of the PD program on patient and method survival rate has been widely discussed by numerous authors. Their opinions differ from positive,[19] through neutral,[20] to negative ones.[21] The latter are substantiated by the adipogenic effect of absorption of glucose from dialysis fluid during chronic PD, the faster and larger drop in residual renal function compared with lean patients, and the proinflammatory effect of the procedure itself with the "internal dializator", that is the constant presence of dialysis fluid in the peritoneal cavity. BMI >30 g/m$^2$ is generally considered to be an independent predictor of a decreased patient and method survival rate. These findings were challenged by Pliakogiannis et al. from Canada. They assessed the survival rate during a 10-year follow-up of 4056 patients, who were put on PD between 1994 and 1998. The authors demonstrated almost identical survival rates of patients with BMI >30 kg/m$^2$ and those with BMI 18.5–29.9 kg/m$^2$, which was significantly higher than that for BMI <18.5 kg/m$^2$. They concluded that patients with BMI >30 kg/m$^2$ should not be disqualified from PD solely on the basis of their obesity.[22] However, these patients require individual approach in selecting an appropriate peritoneal catheter before the peritoneal cavity is accessed.

**Peritoneal dialysis and gender** In western European countries, the United States, and Canada, women constitute 50% to 60% of patients undergoing PD.[8-10] Lack of the relevant data for Poland does not allow us to assess to what extent the gender affects the patient and method survival as well as the rate of complications.

**Peritoneal dialysis and the epidemiology of chronic kidney disease** The data on the population at risk for CKD is highly disturbing. The PREVEND (Prevention of Renal and Vascular Endstage Disease Intervention Trial) and NHANES III (Third National Health and Nutrition Examination Survey) trials estimated this subpopulation at 7% and 12.2% of the world population, respectively, which gives 380 to 870 million people in absolute values. The POLNEF trial, conducted by the Gdańsk center in Poland on a group of 2500 potentially healthy subjects, showed the presence of albuminuria in 15.6% of the subjects, and in 7% when the albuminuria cut-off point was >30 mg/dl. In terms of statistical data, this may mean that albuminuria occurs as a significant cardiovascular and CKD progression risk factor in about 4 million people in Poland.[4]

While the most common causes of terminal renal failure in Poland are diabetic nephropathy (24%) and chronic glomerulopathies (22%), and less frequently hypertensive nephropathy (11%) and polycystic kidney disease (8%), in the United States diabetic nephropathy (45%) and hypertensive nephropathy (28%) are predominant, with a decreasing percentage of chronic glomerulopathies (15%).[5] Renal replacement therapy is conducted in about 2 million people worldwide (20,000 in Poland).[4,5]

PD is indicated particularly in patients with diabetes in the course of cardiovascular complications, because this method does not require vascular access or the use of heparin, and the possibility of diet liberalization with a reduction in hypoglycemia improves the patients' nutritional status. Furthermore, unassisted management of PD by patients with diabetes decreases the degree of disability and improves everyday functioning.

A constant increase in the number of elderly patients, especially those with diabetes, in PD programs has resulted in the emergence of multiple innovative technologies, which are beneficial not only in terms of improving the quality of life, but also optimizing dialysis techniques. These are 2 and 3-chamber containers with a lower risk of error during container selection; shape and color-profiled grip surfaces of linking systems, which are particularly useful for visually handicapped or blind patients; dialysis fluid heaters equipped with thermostats, which reduce the risk of thermal damage to the container or scalding of the patient. Dialysis fluids containing exogenous amino acids are available for malnourished patients.

**Peritoneal dialysis and congestive heart failure** In a report from our center, which has been published in the current issue of the *Polish Archives of Internal Medicine*, we presented the rationale for using peritoneal ultrafiltration in the treatment of CHF resistant to pharmacological therapy.[6] In this disease, it is clear that an increasing percentage of patients with GFR <60ml/min/1.73 m$^2$ in the course of CHF affects the transfer of indications for PD to lower stages of kidney damage (CKD, stages 3 and 4) in relation to the standard indication, which is stage 5 (uremia). We presented the case of a 39-year-old man treated with continuous ambulatory PD for 7 months, which demonstrates the appearance of a new patient group that needs to be covered by PD.[23]

Using PD in the treatment of CHF is beneficial both for the patient and economy. For the patient, this means effective control of overhydration, a reduction in the volume and mass of the left ventricle with an increase in the ejection fraction and improvement of the effectiveness of diuretics. Thus, the patient may require fewer drugs and may be able to return to conservative CHF treatment and dialysis at home. For economy, this means shorter and less frequent hospitalizations, and subsequent lowering of treatment costs.

**The place of peritoneal dialysis in an integrated approach to renal replacement therapy in light of the changing demography and epidemiology of chronic kidney disease** The concept of an integrated approach to renal replacement therapy proposed by Lameire et al., and modified by Mendelssohn et al., assumes that the 3 forms of renal replacement therapy, i.e., HD, PD, and kidney transplantation, are complementary to each other. At the same time, the method of choice should be PD.[24,25] This especially concerns patients motivated towards unassisted dialysis, with preserved residual renal function. Basic elements of this concepts include an early visit to the nephrologist, early preparation and start of dialysis therapy. The modification by Mendelssohn et al. involves additional steps designed to slow down the progression of CKD, such as aggressive treatment of comorbidities, mainly cardiovascular diseases, or kidney transplant in the predialysis period.

The benefits and limitations of introducing PD instead of HD as the modality of choice within an integrated approach to renal replacement therapy are discussed elsewhere.[26]

Method selection is a challenge not only for the patient but also for the nephrologist.[27] The nephrologist, while suggesting PD or HD as the method of choice, should consider the following factors: the patient's preferences, the potential survival rate of the patient and dialysis technique, preservation of residual renal function, risk factors and comorbidities that limit a long-term use of the proposed method.

For those patients in whom the inconveniences of PD outweigh the benefits, HD remains the therapeutic option. According to Mendelssohn et al., the best option is home HD. This form of therapy, which by reducing personnel costs has a beneficial effect on the economy, is yet to find its use in Poland.

**Hope for the future** I am convinced that the following decades of the 21st century will bring an improvement in biocompatibility of dialysis fluids, new and more patient-friendly PD technologies, as well as new education programs, which will make PD more accessible especially for the elderly and in patients with diabetes.[22,28]

Also, transplantation of peritoneal mesothelial cells seems particularly promising as a potential method for restoring dialysis capacity of the peritoneum in patients treated with this method for a long time.[29]

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ARTYKUŁ POGLĄDOWY

# Miejsce dializy otrzewnowej w demografii i epidemiologii przewlekłej choroby nerek

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**SŁOWA KLUCZOWE**
demografia, dializa otrzewnowa, epidemiologia, przewlekła choroba nerek

**STRESZCZENIE**

W XXI w. w populacji chorych poddawanych leczeniu nerkozastępczemu zwiększyła się liczba osób w podeszłym wieku, otyłych, z powikłaniami nerkowymi chorób ogólnoustrojowych, szczególnie cukrzycy i nadciśnienia tętniczego; stale zwiększa się również liczba chorych z zastoinową niewydolnością serca, wymagających okresowo lub na stałe wsparcia dializacyjnego. Zgodnie z koncepcją zintegrowanego systemu leczenia nerkozastępczego dializa otrzewnowa powinna być pierwszą opcją leczenia nerkozastępczego tych chorych, zwłaszcza u osób z zachowaną resztkową czynnością nerek. W pracy przedstawiono dowody na to, że zmieniająca się demografia i epidemiologia przewlekłej choroby nerek wymusza wprowadzanie bardziej przyjaznych opcji terapeutycznych dostępnych dla tych grup pacjentów.

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