Many patients with chronic kidney disease use peritoneal dialysis. Since patients are likely to present in all care settings all nurses need to understand how PD functions.

**PART 1 OF 2: PERITONEAL DIALYSIS**

**Use of peritoneal dialysis in kidney disease**

**In this article...**

- Different stages of chronic kidney disease
- How peritoneal dialysis works
- Patients for whom PD is not suitable

**Key points**

1. More than 2.6 million people aged >16 in England have chronic kidney disease stages 3-5.
2. Diabetes is the most common cause of CKD.
3. CKD can be treated through transplantation, conservative management or dialysis.
4. Haemodialysis and peritoneal dialysis can both be used to treat CKD, but not all patients are suitable for PD.
5. PD can be done manually or with a machine.

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One sixth of patients receiving dialysis in the UK manage their underlying chronic kidney disease using peritoneal dialysis. Although it is generally undertaken at home, non-specialist renal nurses should understand how peritoneal dialysis works. This first in a two-part series describes chronic kidney disease and different treatment options, with a focus on peritoneal dialysis. Part 2 will guide non-renal nurses on how best to care for patients using this treatment option.

The kidneys are situated in the lower back; each contains approximately one million filtering units known as nephrons. Healthy kidneys filter 180 litres of plasma a day to produce just two litres of urine, which drains into the bladder via the ureters. The kidneys also secrete erythropoietin and regulate blood pressure, bone metabolism, acid-base balance, fluid control and electrolyte balance. When the kidneys fail, so do all these vital processes.

**Chronic kidney disease (CKD)** is an incurable and lifelong illness, and is progressive in most patients. Its most common cause in the UK is diabetes, closely followed by glomerulonephritis (a collection of diseases that destroy the kidneys’ filtering process). Other causes are pyelonephritis (kidney infection), hypertension, polycystic kidney disease, renal vascular disease, poisons, nephrotoxic agents (for example, non-steroidal anti-inflammatory drugs). However, in some the cause is unknown (Gilg et al, 2014).

Kidney function can be judged by patients’ estimated glomerular filtration rate (eGFR). This calculation is undertaken via a blood test, and estimates how well the blood is filtered by the kidneys – an eGFR >90ml/min/1.73m2 of body surface area is normal unless there is other evidence of kidney disease (Renal Association, 2013); creatinine level, age, sex and ethnicity are also taken into consideration. CKD can then be categorised into one of five stages. Table 1 details the stages, along with the corresponding action that should be taken.

It is estimated that 2.6 million people aged 16 years and above in England have CKD stage 3-5 (Public Health England, 2014); these patients are also likely to be living with comorbidities such as diabetes and cardiovascular disease (Health and Social Care Information Centre, 2010). Guidelines from the National Institute for Health and Care Excellence (2014) recommend early referral of certain patients to nephrologists – including those with a family history of CKD, or those with symptoms such as proteinuria, haematuria, acute kidney injury, a sustained decrease in eGFR or diseases affecting the kidney – so residual renal function can be preserved, and disease progression slowed down. However, ongoing management is usually a combination of lifestyle, dietary advice and drugs overseen by GPs until the CKD reaches stage 4. From this point onwards, patients will require specialist management by a nephrologist.
the patient then progress towards CKD stage 5, the following options will be discussed:

- Dialysis;
- Transplantation;
- Conservative management.

Many choose dialysis, but this can be delivered in two ways: haemodialysis (HD) and peritoneal dialysis (PD).

**Peritoneal dialysis**

Peritoneal dialysis is a home-based method of dialysis for patients with end-stage kidney disease (stage 5). In HD, a dialysis machine is used to remove the blood from the body, clean and return it. PD uses the body’s own potential peritoneal cavity and membrane as an internal dialysis system. Patients dialyse by instilling clean dialysis fluid (dialysate) into this cavity via a specialist abdominal catheter. After a set period of time, this dialysate becomes waste fluid (effluent), and is then drained away and replaced with fresh dialysate. This “exchange” process can be performed:

- Manually – continuous ambulatory peritoneal dialysis (CAPD);
- By a machine – automated peritoneal dialysis (APD) (Levy et al., 2009).

Patients undergoing PD can experience a wide range of medical and surgical issues, and may be admitted to non-renal areas so it is important that non-renal specialist nurses have some knowledge of CKD and how PD functions.

**How PD works**

The peritoneal membrane is a serous membrane that lines the abdominal wall and surrounds the internal organs. It is 1.5-2m², similar to the patient’s body surface area. It has an excellent capillary blood supply and three semi-permeable layers:

- Capillary wall;
- Interstitium;
- Mesothelium (Teitelbaum, 2011).

Basic dialysate comprises treated water, glucose (or an alternative osmotic agent), electrolytes and buffers. In general, around two litres of warmed dialysate is infused at a time. Once “filled”, the patient has fresh dialysate contained on one side of their semi-permeable peritoneal membrane and a blood supply ready to be cleaned on the other. Under normal circumstances, only a few membrane capillaries are perfused but in the presence of dialysate, blood flow to the membrane increases (European Training and Research in Peritoneal Dialysis, 2012). Fig 1 shows the location of the dialysist catheter and dialysate.

Due to various pressure gradients, the processes of osmosis, diffusion and convection enable excess water and waste from the capillary blood to cross the semi-permeable membrane into the dialysate. Waste-filled dialysate is then drained out via the catheter (Fig 2). This waste should look similar to clear urine. Fresh solution is then drained into the peritoneum (a fluid “exchange”) and the dialysis process is repeated.

Each fluid exchange is performed using aseptic non-touch technique. A clean area is required and the patient will need a metal trolley or other clean surface (not wooden) on which to place their equipment, alcohol hand gel, surface wipes and dressings.

**PD systems**

Both CAPD and APD are designed to gently clean the patient’s blood 24 hours a day, seven days a week.

**CAPD**

Exchanges often occur four times a day and take approximately 30 minutes to complete. Timing is generally:

- First thing in the morning;
- At lunchtime;
- Late afternoon;
- Before bed.

Most patients will have each of the day-time exchanges “dwelling” in their peritoneum for 4-6 hours, at which point a further fluid exchange will be performed. Any exchange before bedtime will dwell for somewhat longer. The overall result is that the patient is benefiting from dialysis 24 hours a day. During each “dwell”, the PD catheter is out of sight and securely taped to the patient’s abdomen.

Patients connect the PD catheter to the tubing of a closed two-bag system. One bag will contain fresh dialysate and is connected by flexible tubing to an empty “drain bag”, which collects the waste (Fig 2). To assist gravity, the fresh dialysate bag must hang above the patient’s head, while the drain bag can lie on the floor (Mahon et al., 2013). This makes the bag as low as possible below the patient to assist drainage by gravity. The drain bag is a self-contained unit (it has no valve for emptying like a urethral catheter bag) and is designed to be placed on the floor.

In hospital, each bag of PD effluent must be weighed and documented before disposal. Patients may bring their own dialysate in from home along with their fluid warmer, which safely heats the fluid to body temperature. They may also use their own supply of ancillary items such as dialysis caps and shields, but their PD nurse can also make alternative arrangements for the supply of all equipment.

**APD**

APD happens while patients sleep; it uses a cycler machine, which is located next to the bed and performs exchanges automatically. Therapy time, dwell time and the number of overnight exchanges are all pre-programmed by the PD nurse. The patient attaches large bags of dialysate to the machine before bed and connects their PD catheter to the system. Dialysate is then drained in and out overnight.

Although APD gives patients freedom during the day, they are committed to 7-10 hours – sometimes more – of dialysis every night. To provide 24 hours of dialysis, the APD machine will often be programmed to instil a final fill of dialysate into the patient at the end of their night-time programme. This final fill will dwell in the peritoneum all day until it is drained out by the machine the next night. Details of each
Choosing dialysis type
There is little evidence to support either PD or HD as an optimal first dialysis treatment, and Couchoud et al (2015) suggest the selection of dialysis modality be guided by patient choice based on unbiased education. However, certain contraindications disqualify patients from PD, regardless of physician or patient opinion. The most common are:

- Previous major abdominal surgeries;
- Morbid obesity;
- Large abdominal wall hernias;
- Active diverticulitis;
- Abdominal wall ostomies and conduits;
- Large abdominal wall aortic aneurysm

Patients may choose PD for various reasons, although arguably, the most common is that as a self-care, home-based therapy, it promotes independence. Other reasons for choosing PD include:

- Visits to hospital are approximately once a month, compared with two or three times a week for HD;
- Diet and fluid restrictions are generally more relaxed;
- Blood results remain more constant;
- Travel, both in the UK and abroad, can be easily arranged;
- Telephone advice is available.

As with any therapy, there are drawbacks to be considered:

- Patients must commit to daily dialysis, self-monitoring and record keeping;
- Without daily laxatives, constipation causes the inner tip of the catheter to migrate upwards from its correct position low in the pelvis – the patient needs to aim for a couple of controlled bowel movements every day;
- An area is required for correct storage of supplies;
- Complications can occur, the most common of which is PD peritonitis caused by bacteria entering the peritoneum, usually via the PD catheter. Signs and symptoms include pyrexia, abdominal pain and cloudy PD effluent with a raised white cell count. Treatment is intraperitoneal antibiotics, which may be self-administered at home if the condition is not severe; however, the infection can be so acute or recurrent that the PD catheter will need surgical removal. The patient will then transfer to HD;
- There is a risk of infection where the PD catheter leaves the body ("exit site infection"). This is generally treated at home with topical and oral antibiotics but serious infection or recurrence can result in surgical catheter removal and transfer to HD. To minimise this risk, the exit site must be kept dry at all times;
- Heavy lifting is to be avoided as raised intraperitoneal pressure can produce hernias;
- There is a risk of encapsulating peritoneal sclerosis – a rare but serious complication of peritoneal calcification and bowel obstruction. This has been linked to various factors including duration on PD, peritonitis episodes and continual use of high-glucose dialysate. Patients now generally use PD for a limited time only (roughly 3-5 years) to avoid this complication. At this point, they will be transferred to HD and it is advisable not to return to PD.

Conclusion
Maintaining independence is crucial to the health and wellbeing of individuals dealing with chronic disease and PD is a very successful method of dialysis for many patients. It is important that ward nurses understand the functions of the kidneys and CKD, as well as how PD can benefit some patients, so they can care for these patients when they present other health problems.

The data reported here has been supplied by the UK Renal Registry of the Renal Association (Gilg et al, 2014, Rao A et al, 2014). The interpretation and reporting of the data is the responsibility of the authors and in no way should be seen as an official policy or interpretation of the UK Renal Registry or the Renal Association.

References

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