

Pediatric Peritoneal Dialysis Fact Sheet

Chronic Kidney Disease Stage 5 – What Is It?

The kidneys are remarkable organs that maintain a constant balance in our body. The kidneys regulate levels of acid/base, electrolytes and mineral, blood pressure, fluids, red blood cell (RBC) production, and bone growth. Chronic kidney disease (CKD) is an abnormality of kidney structure or function for more than 3 months. CKD is classified into 5 stages based on estimated glomerular filtration rate (eGFR), with CKD Stage 1 indicating normal GFR and CKD Stage 5 representing kidney failure or end stage renal disease (ESRD). GFR is a determination of the kidney function. In patients aged 1 to 16 years, eGFR can be determined by using the following formula; $eGFR = k \times \text{height (cm)}/\text{serum creatinine (mg/dL)}$ $k = 0.413$ (Pirojsakul, Mathews, & Seikaly, 2015). Children with CKD Stage 5 (ESRD) may experience lethargy, fatigue, decreased urine output, attention deficits, anemia, bone disease, and hypertension. The treatment of patients with ESRD involves the use of medications, special diet, and dialysis or transplantation.

Peritoneal Dialysis: What Is It?

Peritoneal dialysis (PD) is the most common treatment option for children less than 5 years of age with CKD Stage 5.

PD has several advantages over hemodialysis:

- Preserves residual renal function.
- Less dietary and fluid restrictions.
- Less disruption to the patient's daily activities (Chua & Warady, 2017).

Disadvantages include:

- Burden on the caregiver to perform dialysis at home.
- Time away from work or other responsibilities to learn how to perform PD and attend monthly clinic appointments.
- Life-threatening infection risk if aseptic technique is not followed.

The patient (when age appropriate) and/or the patient's parents/caregivers are trained by an experienced nurse to perform peritoneal dialysis. The training includes instructions on how to set up the peritoneal dialysis machine, determine the dialysis solutions, monitor for signs and symptoms of infection, and properly clean the PD catheter

exit site. Typically, training occurs in the PD unit in the outpatient setting, but training may also occur while the child is hospitalized.

PD requires surgical placement of a catheter into the patient's peritoneal cavity. The catheter is tunneled under the child's skin to prevent infection. There are 1 to 2 cuffs on the catheter that can be felt under the patient's skin. The cuffs help prevent infection and keep the catheter secured in place. The PD catheter extends from the patient's abdomen, and is connected to the dialysis tubing and solution. A warmed, sterile electrolyte solution, called dialysate, is instilled into the abdomen and allowed to dwell for a prescribed period of time. The peritoneal membrane lines the peritoneal cavity and functions like a filter when the dialysate is placed into the peritoneal cavity. Waste products usually cleared by the kidneys are instead removed in the dialysate solution. Waste products or solutes, such as urea, move across the peritoneal membrane into the dialysate. This process of solute removal from a high concentration of solutes in the blood to low concentration of solutes in the dialysate solution is called diffusion. Osmosis occurs when excess water from the patient crosses over the peritoneal membrane into the dialysate solution in response to the hypertonic glucose concentration in the dialysate.

PD solutions are manufactured in several different glucose concentrations to help control the amount of fluid removed from the patient. The higher the glucose concentration, the more fluid is removed. The dialysate remains in the peritoneal cavity for a prescribed period of time, then it is drained from the peritoneal cavity and replaced with fresh dialysate. This cycle is repeated several times within a prescribed time. The process of instilling dialysate, dwelling the dialysate in the peritoneal cavity, and draining the dialysate is called a cycle or exchange. Several cycles occur overnight or during the day, depending on the type of PD prescribed.

PD is considered a desirable therapy for children because it allows for regular school attendance and extracurricular activities. PD is performed daily; therefore, diet and fluid intake may be less restrictive. However, PD in the home requires significant commitment from parents/caregivers. They must demonstrate the ability to safely and accurately perform dialysis and catheter care, as well as verbalize understanding of when to call their dialysis center or nephrologist. Parents/caregivers must be able to PD daily

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and attend monthly clinic visits with their child. The home environment must allow for storage of large amounts of dialysis solution, equipment, and supplies. The child should have an area free from drafts and foot traffic to perform catheter care and PD treatment. As the educator and primary nurse, the role of the PD nurse is an essential component in the success of the pediatric home PD patient.

Types of Peritoneal Dialysis

There are two types of PD: continuous ambulatory peritoneal dialysis (CAPD) and continuous cycling peritoneal dialysis (CCPD).

CAPD requires fresh dialysate to be instilled manually into to peritoneal cavity via the PD catheter. The dialysate dwells for 3 to 5 hours, then it is drained from the peritoneal cavity. CAPD does not require a machine, but it does require the catheter to be opened frequently to allow for several exchanges a day. There is a greater risk of infection with CAPD than with PD modalities that utilize machines.

CCPD is the most common type of PD used in children. CCPD, or automated peritoneal dialysis (APD), requires the patient to be connected to a machine (cycler), which controls the exchange of the dialysate fluid over a period of 8 to 12 hours. This may be easier for the family/caregivers because the child receives dialysis in the comfort of his or her home while asleep. The timing of starting and stopping dialysis can be tailored to match the child's and family's schedule.

Care of the Peritoneal Dialysis Catheter

Catheter care consists of careful assessment and observation and meticulous sterile dressing changes for a period of 2 to 4 weeks after catheter placement or until the catheter exit site is healed. After it is healed, the dressing is optional unless the patient wears diapers or has a gastrostomy tube, colostomy, vesicostomy, or any other drain or condition that would be a potential source of contamination to the PD catheter site. In all cases, continued use of dressings at the PD catheter exit site is recommended. The catheter should also be stabilized securely to the abdomen to avoid any trauma or injury to the exit site. Any redness, streaking along the tunnel, drainage, bleeding, or leaking of dialysis fluid should be reported to the PD nurse and nephrologist immediately.

The catheter should remain closed when not in use. Most PD catheters have a piece of tubing attached called an extension set or transfer set. The transfer set is a small segment of tubing with a clamping device placed on the end of the catheter in a sterile environment. All catheters have a sterile cap placed on the end to keep the catheter closed in a sterile manner. If the extension set becomes detached or the sterile cap comes off unintentionally, the PD nurse and the nephrologist should be notified immediately. If the catheter end is exposed or contaminated by coming in contact with non-sterile items, there is a risk of peritonitis, a potentially life-threatening infection of the peritoneal cavity. Symptoms of peritonitis include fever, abdominal pain, vomiting, diarrhea, or cloudy dialysate drainage. The PD nurse and the nephrologist should be notified immediately if these symptoms occur.

Volume and Blood Pressure Control

Patients on PD may have high or low blood pressure. Fluid status may play a role in blood pressure. Parents/caregivers should monitor both weight and blood pressure at home. Weight greater than the patient's estimated dry weight (EDW) after dialysis may mean the patient is fluid-overloaded (hypervolemia), and this could contribute to high blood pressure. Edema and headaches may be symptoms of volume-related hypertension. It is possible to have high blood pressure in the absence of fluid overload.

In contrast to too much fluid, patients on PD can also experience symptoms caused by too little fluid (hypovolemia). Patients who are hypovolemic may experience symptoms of dizziness and low blood pressure. Patients may become hypovolemic if too much fluid is removed during dialysis. In this case, their weight after dialysis would be below their EDW. Hypovolemia can be the result of vomiting, diarrhea, or excessive sweating during summer months. Symptoms, as well as blood pressure and weight measurements that are out of desired range for the patient, should be reported to the nephrologist. Because children should gain weight with normal growth, home blood pressure and weight data, as well as physical examination, should be utilized to frequently evaluate EDW. Weights greater than the EDW after dialysis with normal or low blood pressures and no noticeable edema may indicate actual weight gain that is associated with a child's normal growth.

Medications

Adherence to fluid restriction, dietary restriction, and medication regimen are necessary along with dialysis treatment for optimal patient outcomes. Below are some common medications associated with children receiving dialysis.

- Calcium carbonate (TUMS®), sevelamer (Renagel®, Renvela®), Calcium acetate (Phoslo®) – Phosphorus binders taken with meals and snacks to decrease bone loss.
- Calcitriol (Rocatriol®) – Vitamin D analog that helps manage low calcium levels and treat bone disease
- Epoetin alfa (Epogen®), darbepoetin (Aranesp®) – Promote RBC production. Injections are usually given twice per week. Darbepoetin is long-acting and usually given monthly.
- Ferrous sulfate (Niferex®) – Iron supplements; treat iron deficiency, anemia.
- Multivitamins – Used as supplement for vitamins lost during dialysis treatments.
- Human growth hormone (HGH) – Long-term treatment for growth failure, daily injection.
- Antihypertensives – Treat high blood pressure.
- Docusate sodium (Colace®), polyethylene glycol (MiraLAX®) – Stool softeners to relieve constipation associated with peritoneal dialysis.

Children on Peritoneal Dialysis: What Is the Goal?

The goal for children on PD is optimal patient outcomes to remain as healthy as possible to qualify for a kidney transplant. Patient care is very individualized and based on the child's health status, physical age, emotional age, parental/caregiver support, and resources, as well as many other factors. Not all children qualify for a kidney transplant; therefore, the goal is to maintain optimal health and successfully transition into the adult dialysis environment.

References

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- Pirojsakul, K., Mathews, N., & Seikaly, M.G. (2015). Chronic kidney disease in children: Recent updates. *The Open Urology & Nephrology Journal*, 8(Suppl. 3), 117-123.

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