RPA
Renal Physicians Association

POSITION PAPER

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# Peritoneal Dialysis Urgent Starts

## Executive Summary

Almost 80% of dialysis initiation in the USA and Canada is via a central venous catheter (CVC) for hemodialysis (HD), and HD is inevitably a default choice. Starting HD with a CVC is independently associated with increased mortality and high rates of bacteremia.[1-5] Despite early nephrologist referral almost half of the patients (56%) initiate dialysis sub optimally, even though several studies have shown that nephrologists would not select in-center HD with a CVC for themselves or their families. [6,7] Given this information it is reasonable to explore peritoneal dialysis (PD) as an urgent initiation modality. Studies have compared urgent-start HD to PD and found that urgent-start PD is a safe and effective alternative to HD for unplanned dialysis starts. [8,9]

Thus, RPA believes the current paradigm for dialysis initiation should be reassessed. This seems especially true in light of the national call to increase the utilization of home dialysis as part of the “Advancing American Kidney Health” initiative announced in July 2019. The standard of care should be to optimize patient choice of dialysis modality while offering robust and well-developed systems of home dialysis support that foster informed decisions made in favor of home therapies. The RPA believes that urgent start PD should be part of this strategy.

## Introduction

When patients with advanced chronic kidney disease (CKD) choose to initiate PD, the chronology of events usually proceeds with a surgeon, interventional nephrologist, or interventional radiologist inserting a PD Catheter, followed by team coordination among the nursing staff, social worker and nephrologist to help insure a smooth transition. Ideally, these events occur after the patient and family have been educated about PD and then can proceed with appropriate training.

This paper focuses on the considerations for an urgent start program and best practices for urgent start PD for patients with end-stage renal disease (ESRD). The recommendations outlined in this paper are based on current best practices, expert opinion and collective clinical experience, as well as observational research.

## Definition of Urgent Start PD

The timing of when to insert the PD Catheter and initiate PD is not precise but is centered on the symptoms of kidney failure and the patient’s underlying metabolic and volume status.

"Acute PD," often used interchangeably with "urgent start PD" refers to initiation of PD **within 72 hours** of catheter insertion, utilizing low volume, infrequent PD exchanges, with the patient in the supine position. Once the PD catheter insertion site has healed, then commencement of regular PD prescription ensues.

Alternatively, some would refer to “urgent start PD” as the use of the PD Catheter **within 2 weeks** from the time of its insertion which is often called early start or low volume incremental PD. It is considered as a welcome alternative to HD via CVC for patients who manifest significant volume overload or uremic signs and symptoms and thereby require unplanned initiation of dialysis [10].

As Blake explains, "it is a strategy whereby patients with advanced CKD who urgently and unexpectedly need dialysis... are treated with PD." He also adds that the term "urgent start" PD should be reserved for patients with truly urgent presentation requiring PD **within 72 hours** of catheter insertion. The more "elective variant," where PD is started **between 3-14 days** after catheter insertion and HD sometimes is used initially, is best termed as "early start PD," and it is predominantly an outpatient procedure performed in a non-emergent manner. [11] Early start PD has also been referred to as low volume incremental PD.

| Type of PD | Timeframe | Considerations | Setting | Indications | Risks |
|---|---|---|---|---|---|
| Traditional PD | PD catheter insertion and initiation of training after a 2- to 4-week healing period (4) | - Planned over long-term<br>- Electively started in anticipation of clinical decline | Outpatient | No urgent clinical need to initiate PD | Overly early initiation |
| Early Start PD (aka Low volume incremental PD) | Within 3-14 days of PD catheter insertion; HD is sometimes used initially | - Planned over short-term<br>- Electively started in response to clinical symptoms | Outpatient | Non-emergent clinical need to initiate PD | Symptoms evolve to rapidly to be accommodated by initiation of PD |
| Urgent Start PD (aka Acute PD) | Within 72 hours of PD catheter insertion | - High risk<br>- Unplanned<br>- Urgently started in response to clinical symptoms | Inpatient/ Outpatient (contingent on infrastructure/ organization) | - Requires low fill volumes in the supine position | - Higher incidence of leakage and possibly peritonitis<br>- Catheter malfunction becomes urgent<br>Cost: Less than HD |

In essence, urgent PD (both acute and early forms) may be a stressful situation requiring a great degree of organization (10-13).

**Rationale for Urgent Start PD**

Observational studies suggest superior outcomes can be achieved with urgent start PD when compared to dialysis initiation via CVC. Randomized clinical trials comparing urgent start PD with HD with CVC are lacking which may be a reason urgent start PD is not the default choice; Despite the formidable risks of starting HD with a catheter [14, 70], an RCT of this nature is unlikely to be conducted, thus serious consideration of the need for more widespread use of urgent start PD, especially in regions and practices with sufficient nursing and surgical support is warranted.

The logistics and practicalities of initiating urgent PD as such that it is much easier to initiate urgent dialysis by placing a CVC and then ordering hemodialysis. Convention has established easy and widely embraced pathways in all facets of dialysis care to continue a practice that is rife with complications (i.e., use of a CVC), and, again, most patients have no choice in the decisions made on their behalf. Instituting a change in the current clinical paradigm will be challenging, but at the very least, all incident dialysis patients lacking strong contraindications should have the opportunity to choose urgent start PD.

**Urgent Start Program Initiation**

*Infrastructure and clinical considerations*

The initiation of urgent start PD requires an infrastructure of clinical pathways with the capacity to meet the unique logistic challenges associated with this modality. This will include a team of educators readily available and well versed in the implementation of the following: (1) urgent start PD; (2) mechanisms for rapid PD catheter placement; (3) early initiation of PD therapy with a modified prescription; and (4) adequate staffing, nursing, and dedicated space. The setting in which these requirements are available will be location and practice specific and will determine if urgent start PD will be offered in an inpatient or outpatient setting or perhaps both, which would be the most ideal.

Additionally, timely access to durable, safe, and permanent PD catheter placements with a low complication rate is needed. Catheter design and placement techniques are critical, and placement should be performed by clinicians skilled in the procedure.

Clinical and workflow processes are necessary for urgent catheter placement. Optimally, the nephrologist will meet with the appropriate surgeon or interventionalist to educate them regarding the concept of urgent start PD and the need for patients to be seen in a timely fashion to circumvent the need for placement of a CVC. Patient education, described in detail below, must also be addressed.

From a nursing perspective, new clinical pathways will be required, and staffing needs will likely be more demanding. The patients will need more assistance than a normal PD patient trainee with such activities as assistance with assuming the recumbent position for

the first few sessions that are performed supine, and closer monitoring during the several hours of therapy while in center, as well as providing instructions and education.

Finally, financial concerns play a role in the burden of disease on patients. PD can be a more favorable therapy for Medicare eligible patients who are not yet beneficiaries. This PD centered benefit should be of some consideration, as Medicare coverage will be retroactive to the first day of the month PD was initiated and will pay the surgical fees up to its liability.

*Best Practices for Patient Selection*

Review of literature suggests there are no absolute contraindications in patient selection criterion for urgent PD starts except patients with life threatening hyperkalemia. Urgent start PD is not generally used in the case of toxic overdoses or poisonings. Urgent PD start is feasible in varied different presentations.[15] In some cases modality of catheter insertion can add to initiation time. Likewise, in some cases percutaneous catheter placement is not feasible due to morbid obesity or adhesions secondary to multiple abdominal surgeries. In those instances, expertise with laparoscopic or open surgical procedures is warranted.

Exclusion criteria are similar for patients who have traditional PD. Patients selected for urgent start PD are the patients who are good candidates for traditional PD. [16-18] Incremental dialysis may preserve residual renal function and improve survival in comparison with full-dose dialysis. A metanalysis done by Garofalo et al, suggests that incremental hemodialysis and PD in general allows longer preservation of residual kidney function thus deferring full-dose dialysis, by about 1 year in HD and PD, with no increase in mortality risk. Overall, time to full-dose dialysis was similar between incremental hemodialysis and incremental peritoneal dialysis, thus showing no difference between incremental HD and incremental PD for outcomes per current evidence. [19]

*Best Practices for PD Catheter Placement*

Catheters placed for urgent start should be chronic catheters with selection based on patient size and body habitus. Best practices at this time indicate that, generally, all adult patients should have a 2 cuffed catheter placed with either a straight or coiled intraperitoneal segment. Experienced clinicians may choose to place catheters with an extended segment for obese patients or those desiring a presternal catheter.[20]

*Techniques*

Urgent start PD catheters can be placed by surgical or interventional procedures, but a system needs to be in place to allow for rapid (within 24 hours) placement and immediate use. There is no clear evidence to support a specific technique or operator specialty, but clinician expertise is essential. The clinicians should be involved with the PD program and surgical success and complications should be monitored.

Surgical placement can be open or laparoscopic. Laparoscopic surgeons should ideally be able to employ advanced adjunctive procedures such as omentopexy, omentectomy, adhesiolysis and hernia repair to reduce subsequent complications.  Percutaneous

techniques should utilize image guidance when available to reduce complications and improve outcomes.[20]

*Placement*

The exit site location should be planned to avoid the beltline and pannus. The patient should be examined in the standing and sitting positions to determine location of the beltline and the exit site. A bowel cleansing regimen should be implemented. If an enema is necessary, do not use a phosphate containing material. Prophylactic antibiotics should be given during the preoperative period. [21] Best demonstrated practices suggest placement of the deep (distal) cuff in or under the rectus sheath to prevent leaks.[22-24] The catheter should be tunneled through the rectus sheath directing the catheter to the pelvis to prevent or reduce catheter migration. Addition of a purse string at the peritoneum and /or above the rectus sheath entrance may be helpful to reduce leaks as well.[25-32] The catheter tip should be directed in the anterior pelvis. Subcutaneous tunneling should be created with a smooth tunnel driven by the intra cuff segment (straight or swan neck) and without strain or kinking of the tunnel. The exit site should be created with as small a hole in the skin as possible and the superficial cuff should be at least 2 cm from the exit site.[33] This minimal distance is required because over time there will be cuff migration towards the surface and exit site. The exit site should be downward or laterally directed to reduce the incidence of exit site infections. [20] There are to be no exit site sutures and avoid anchoring sutures. Immobilize the catheter with a non-occlusive dressing and leave it in place for a week, unless soiled.[34] For urgent starts, the catheter adapters for dialysis should be dressed and anchored outside of the non-occlusive dressing. The catheter should be easily accessible by nursing staff so peritoneal dialysis can be performed without disturbing the exit site dressing, causing trauma to the exit site or cuffs, or pulling on the catheter.

Catheter placements, complications and success should be monitored regularly by the team involved in the urgent start program – nursing, nephrologists, surgeons and/or interventionalists. If the patient is in the hospital, daily monitoring of the proper dressing, anchoring and immobilization is very important. Success of the program will be dependent on the quality of catheter placements with adjustments in technique and urgent start care process to improve delivery and success.

**Patient Education**

A dedicated team including a nephrologist and a home dialysis nurse should be readily available to educate the patient regarding modality options including PD, HD, and transplantation. The nephrologist would educate the patient and their family as to the need for imminently starting renal replacement therapy as well as the need for an urgent PD catheter placement. They should be informed that placement of a tunneled HD catheter may be required in some cases and possibly also procedures to create a permanent AV access. Warnings and advice about protecting arm vessels must be emphasized. The discussion will also include the risks associated with the insertion of a PD catheter and those associated with an urgent start PD therapy including catheter malfunction, leaks and peritonitis.

A dedicated home dialysis nurse would also meet with the patient and the family to further review the procedures required for starting therapy as well the lifestyle implications and

benefits of a home-based versus in-center based programs. The quality-of-life benefits and gentle transition into renal replacement therapy with PD would also be reviewed. The nephrologist, social worker and nurse should ascertain if they would be a candidate for PD and interested in pursuing this as the modality of choice. Included in this discussion should be a social evaluation reviewing home status (cleanliness), access to bathroom and sink, space for PD solutions, employment and associated needs, and family support. The nephrologist will also review the medical / surgical evaluation including functional status, abdominal surgery history, psychiatric or memory issues and vision and/or hearing impairment.

**Initial PD Setting**

*Outpatient*

The outpatient setting would be preferred if the resources are available, with the understanding that the potential need for inpatient observation status or admission will need to be assessed in the postoperative recovery. [35,36] The typical patients considered for outpatient urgent start PD would include established patients in a nephrology practice who are acutely ill or symptomatic or late referrals with advanced CKD stage 5 (lacking uremic symptoms) who require more urgent initiation of therapy and are not in need of admission to the acute hospital setting.

Optimally, the surgery could be performed as an outpatient. If no complications arise and the patient is discharged on the same day, arrangements should be made for the patient to be seen in the outpatient dialysis unit within 24 to 72 hours of insertion of the catheter. Patients are educated and provided with detailed instructions regarding catheter care for the first week post catheter insertion as well as when to contact the nurse or nephrologist.

Post placement, the initial assessment by the nurse should be focused on uremic symptoms and volume status and relayed to the nephrologist after the patient's arrival to the unit. The abdomen should also be examined for any signs of exit site bleeding, dialysate leak or tenderness. This will also determine whether general training in the principles of PD are initiated right away or delayed a few weeks until the patient is adequately dialyzed for better comprehension. The patient should also be educated regarding appropriate bowel regimen to prevent constipation that could impact catheter function.

*Inpatient with outpatient transition*

Urgent start PD programs should be capable of initiation in either the hospital or outpatient setting. The hospital setting should be selected for those patients requiring admission post catheter insertion, patients with more advanced uremia, electrolyte and acid base abnormalities, or those who have unstable concurrent medical problems. The outpatient setting can be reserved for those with urgent rather than emergent needs for dialysis therapy.[12] This option also may be restricted to those patients who are not critically ill and require an ICU, but rather are able to be admitted to a general medical surgical floor. It is difficult to have a cadre of nurses well versed in PD available in the ICU and the manpower needs of incorporating one of the staff nurses from the med surgical floor who is well versed in PD may be prohibitive.

Hospital starts will require the education of the administration, case management and nursing staff regarding the benefits of such a program to establish buy in and support to make the program successful. These meetings should ideally include the outpatient administrative and PD nurses. A protocol can then be developed for the initiation of the urgent start PD hospital program so there is a seamless transition from the inpatient to the outpatient setting as soon as the patient is clinically stable for discharge per the evaluation of the nephrologist, without need for delay for discharge planning reasons. What would be optimal but is not always feasible would be for the PD nurse from the outpatient clinic to see the patient during the hospitalization to assist in this transition.

A dedicated team of hospital nursing staff who routinely perform PD must be provided an extensive education program regarding the differences between urgent start and conventional PD. This education will include information regarding the need to use smaller volumes with shorter times to start followed by a gradual increase. Until healing is advanced, recumbent positioning should be used when dialysate is dwelling. Patients may ambulate only during the periods they are drained of dialysate. The timing of when patients are allowed to be upright with a full abdomen will vary by patient and clinician. Depending on the availability of equipment, the therapy can be initiated with CAPD, APD or a combination. A benefit of in-hospital starts is that longer treatment times can be utilized such as overnight cycling which cannot be performed in the out-patient training unit.

*Initial hemodialysis for stabilization with quick transition goal to PD*

A third option would be to provide an urgent start with a CVC and intermittent HD or continuous therapy in the critical care setting. This also would be reserved for those patients with severe and life-threatening electrolyte and acid base abnormalities, or severe volume overload with respiratory compromise and need for rapid ultrafiltration. Once they have stabilized and been deemed to have irreversible ESKD and have the capacity to comprehend an educational program regarding modality options with their families (if interested), they can then be placed into the urgent start PD program in the hospital during their recovery from their acute illness.

*Inpatient starts with admission to a PD centered area of care in hospital if available*

As a last option for these urgent start PD patients, they can be treated at outpatient PD centers in hospitals if the program is available. These patients would have an urgent start PD in the hospital after catheter insertion and then transition to the hospital dialysis clinic 3 to 4 times a week for 8 to 12 hours of PD with APD.

**Best Practices in Initial PD prescription**

*Relevant PD Concepts for Dosing*

Before deciding how to prescribe urgent start PD, one must determine the goals of the therapy. If and when to start is dependent on need and whether it is reasonable to wait 1 -2 weeks before initiation. If unable to postpone dialysis therapy, nephrologists should determine the indication for dialysis (control of volume, potassium, and uremic symptoms) and this may require some finesse and individualization to the therapy prescription.

Several protocols for the volumes and dwell times including the utilization of both manual incremental continuous ambulatory peritoneal dialysis (CAPD) and cyclers with automated peritoneal dialysis (APD), as well as combinations of CAPD and APD protocols, have been successful.[37-42] These urgent start PD prescriptions, if initiated with smaller volumes (typically around 500-750 ml / exchange) and shorter dwell times (typically 30 to 45 minutes and then gradually increased over a 1 to 2 week period and with the patient supine during the first 2 to 4 days of therapy), have been shown to be well tolerated and associated with acceptable risk of complications, especially a reduction in the incidence of dialysate leak. [13, 66] Many regimens have been evaluated and no clear optimal prescription demonstrated. In general, lower volumes are used to decrease intraperitoneal pressure and exchange frequency tends to be higher. The nephrologist must consider the patient's need for ultrafiltration and clearance. These published studies are for the most part, small, retrospective, single center, observational studies, so specific guideline recommendations are difficult to make as to which protocol is optimal. Koch et al reported in a study comparing urgent start PD vs HD that urgent start PD had less risk of complications than HD, with the latter having a significantly higher risk of bacteremia perhaps due to the CVC.[43] Liu et al in a single center study compared APD to CAPD to a combination of APD and CAPD regimens, demonstrating that the overall incidence rates of catheter displacement and dialysate fluid leak was not increased with these methods of initiation of urgent PD starts.[37]

The severity of the uremic symptoms and the status of residual renal function are the most significant factors in the early dialysis prescription.

*Intraperitoneal pressure*

Rationale for reducing volumes in urgent start PD is related to concerns with increasing intraperitoneal pressures (IPP) with increasing intraperitoneal volumes (IPV). Studies have shown IPP to increase with IPV, body mass index (BMI), straining at bowel evacuation and positioning. Positioning's impact is lowest at supine and rising with standing and even greater with sitting. The greater the BMI, the greater the resting (dry) IPP and hence larger BMI are associated with even greater IPP. Therefore, increasing volume for larger patients may not be a rationale driver of urgent start PD. The rise in IPP with increasing IPV is relatively small in the supine position. DeJardin in the descriptive paper on IPP noted a 1.33 ± 0.44 cm $H_2O$ for each 500 ml of additional volume infused.[44] Therefore, in a supine patient the increase in IPP between 1000 and 2000 ml is only 2.6 cm $H_2O$. Additional rise in IPP has been measured to be 2 – 4 cm $H_2O$ with standing and an additional 1.5 – 2 cm $H_2O$ with sitting. [45, 46] Therefore body positioning is more important than fill volume to reduce IPP. If desired IPP can be measured and individualized. Technique description is well documented in the DeJardin paper. [44]

*Urea/Creatinine/Potassium clearance and fill volume/dwell time*

Clearance of small molecules is dependent on volume, saturation and hence, dwell time, of PD solutions. The urgent PD prescription should consider clearance of urea and potassium as clinically relevant. Although, PET is not measured until far out of the urgent start time period, we know an average D/P urea is about 0.9 at four hours. Further based on PET studies, D/P urea is around 0.5 the first hour and 0.7 the second hour. Therefore, if reference is 4 hours, 55% is equilibrated at 1 hour and 77% with a 2-hour dwell. To put into

perspective, two 1 liter 1-hour dwells will clear 40% less urea or potassium, compared to a 2 liter 2 hour dwell (Note: dwell times).[47]

Based on clinical needs, prescription volume and dwell times should be prescribed to meet the clinical needs as determined by the prescribing nephrologist.

*Salt And Water Movement as a Function of Fill Volume and Dwell Time*

Salt and water transport differently in PD versus other forms of renal replacement therapy. In the peritoneum there are small and large intercellular pores, large pores, lymphatic absorption and aquaporins. These affect transport characteristics and water movement differently. For purposes of this discussion ultrafiltration refers to water movement with or without accompanying solute. For the circumstance of urgent start, we make some assumptions for the general population and then individualize based on the patient's response to therapy. Maximal ultrafiltration (UF) occurs at different time points depending on UF transport status and solution composition.

In the first 1.5 hours, there is little difference in UF rate with a 2.5 % exchange between the transport types. The curves deviate shortly thereafter and peak UF is not achieved until 3 – 8 hours depending on transport characteristics (high transported peak UF is around 3 hours and low transporters around 8 hours). Rates and volume of UF are of course dependent on dextrose concentration and increased with increasing dextrose. Overall UF volume is maximized with 2 – 3 hour.[48]

Since up to 50% of the early UF is through aquaporin channels, water is removed preferentially to sodium in the first 1 – 2 hours. Therefore, rapid exchanges of 1.5 hours or less leads to more water removal than sodium and may increase serum sodium and thirst (sodium sieving). This is measured by Na concentration declining in the PD fluid for the first 90 minutes of a dwell. They start to rise in general after the first 90 minutes and appreciable Na appearance in the dwell occurs at 3 hours.[49]

Therefore, to remove salt and water, longer dwells and larger fill volumes may be required.

**Best Practices for Advancing PD Prescription to Goal Kt/V or Other Targets**

*General Timeline*

As the initial treatment of an urgent start PD patient will involve low volume incremental therapy that also relies on residual kidney function, initial clearance may not be adequate. This process though is usually concluded within the first month. As per 2006 KDOQI guidelines, the minimal "delivered" dose of total small-solute clearance should be a total (peritoneal and kidney) $Kt/V_{urea}$ of at least 1.7 per week in patients with residual renal function (RRF), considered to be significant when urine volume is > 100ml/day, measured within first month after starting peritoneal dialysis. [50] For patients without RRF, the minimal "delivered" dose of total small-solute clearance should be a peritoneal $Kt/V_{urea}$ of at least 1.7 per week measured within first month after starting peritoneal dialysis. The goals here for urgent PD align with traditional PD after the initial start prescriptions and can be adjusted in patients who do not reach this goal or have uremic signs and symptoms. One can first increase instilled volume per exchange before increasing the number of exchanges

per day, especially to increase small-solute clearance and minimize the cost. Increasing the number of exchanges may have a greater benefit in increasing ultrafiltration, but also may lead to insufficient compliance. The exchange volumes of the supine exchange(s) as in long nighttime dwell should be increased first because the increases in IPP are less for a given dwell volume in supine or recumbent position compared with either sitting or standing. To optimize middle-molecule clearance in patients who have minimal RRF, the PD prescription should preferentially include dwells for most of the 24-hour day. Continuous (rather than intermittent) (24 hours/day of PD dwell) PD prescription should be used. This is recommended even if small-molecule clearance is above target without the longer dwell because in PD patients, middle-molecule clearance is time dependent and not significantly influenced by dialysate flow rates or dwell volumes.

*RAS blockers/loop diuretics*

RRF is associated with decreased mortality and better outcomes in patients receiving peritoneal dialysis. [50-53] In the CANUSA study, for each 5 L/week per 1.73 $m^2$ increment in GFR, there was a 12% decrease in the relative risk (RR) of death and for a 250-ml increment in urine volume, and there was a 36% decrease in the RR of death. Hence it is very important to preserve residual renal function.[53, 69]

Although angiotensin converting enzyme inhibitors (ACEi)and angiotensin receptor blockers (ARB) have been used for preservation of RRF in PD patients, the results have been conflicting in numerous trials. Previously two small randomized controlled trials showed a slower rate of decline in RRF in those treated with ACEI (ramipril) or ARB (valsartan) vs. placebo. These trials included only Asian patients using continuous ambulatory PD. An observational cohort study by Shen et al did not find ACEI or ARB use to be associated with a decreased risk of anuria in a large, diverse cohort of patients with multiple comorbidities initiating PD in the U.S. from 2007 to 2011, although the observational study was limited by residual confounding. [56,63]

A meta-analysis in Cochrane Reviews reported use of neutral pH, low GDP PD solutions (“biocompatible PD solution”) and improved RRF preservation. Better preservation of RRF was evident at all follow-up durations with progressively greater preservation observed with increasing follow up duration, and it also showed improved residual urine preservation.[57]

Fluid management is an important aspect in peritoneal dialysis patients, however maintaining euvolemia can be challenging. Hypovolemia is detrimental to RRF but hypervolemia is equally detrimental. Bioimpedence data predicts worse outcomes with hypervolemia. In addition to salt and fluid restriction, diuretics can help with volume control in overloaded patients but there is no data to support that loop diuretics help maintain RRF. A study by Van Olden et al. concluded that high-dose furosemide for 48 hours is effective in CAPD patients in increasing urine volume and electrolyte excretion without affecting urea and creatinine clearance. [60] Medcalf et al. showed that long-term furosemide produced a significant increase in urine volume and improvement in fluid balance but had no effect on preserving residual renal function. [61] With urgent start patients who may begin PD in volume overload while facing an initial prescription that may not be adequate, loop diuretics can benefit these patients early in their treatment just as they are beneficial to prevalent PD patients.

**Best Practice Goals for Dealing with Complications of Urgent Start**

The purpose of this section is to address common complications of urgent start PD that may arise when therapy is initiated and during training for this modality. These issues are also seen with routine or non-urgent PD initiation and this section does not want to be overly prescriptive nor does it seek to be a comprehensive overview of PD therapy troubleshooting which is already established in clinical practice and well described in the literature. As always, the judgment of the clinician for an individual patient's care is paramount. A strong and guiding principle of complication management begins with prevention. Best practice for avoiding these complications is addressed earlier in this paper. If issues are tied to a particular interventionalist or surgeon then ameliorating technique deficiencies with catheter placement will promote a more successful urgent start program and reduce your complication rate.

*Catheter site leaking*

Challenges with the function of the PD catheter will arise in an urgent start PD program. The most common issues are leakage of fluid around the exit site, slow or positional drainage of dialysate, and complete malfunction of the catheter. Rates of mechanical complications of the catheters within the first month in urgent start programs in published reports have ranged from 4.1 to 12.1 percent. [66-68]

Leakage of PD fluid from the exit site or into the abdominal wall is a concern. Most patients initiating therapy will retain some degree of urine output and clearance. At intake, it is recommended and general practice to obtain labs on a patient and to assess their overall wellbeing, underlying comorbidities, cognitive function, and volume status. Despite following best practices for PD catheter placement, avoiding constipation or coughing and starting therapy in a recumbent position a patient may have fluid drain from their exit site. Sometimes this fluid is serous or serosanguinous effluent from the post-operative effect of catheter placement. The fluid should be tested for glucose with a glucometer if a determination is needed to discern dialysate from serous fluid from the newly placed catheter.

Often, a brief respite of a few days is all that is needed for a catheter leak to resolve. An assessment of the patient before doing a respite should include a review of their volume and metabolic status. The temporary transition to hemodialysis via a CVC is rarely necessary but should always be considered for a patient with significant uremia or frank fluid overload. Diuretics as mentioned earlier can often address the latter concern.

If a catheter continues to leak despite a respite then reassessing the aforementioned clinical status is recommended. Sometimes the leakage is waning and there is an expectation that the issue will resolve without active intervention. For a patient that is in acceptable clinical state, further waiting is reasonable. While there is no firm guideline on when to refer a patient back to an interventionalist or surgeon to address a leaking catheter, over one to weeks of leakage is very concerning and should prompt an interventional or surgical evaluation. Whether to pursue hemodialysis in the interim is up to the clinician's judgment but is not always imperative in a patient with significant residual renal function. Clinical and laboratory reassessment is necessary. It can benefit the patient with a persistent leak to transition temporarily to hemodialysis to prevent hypervolemia or uremia and wait two or

more weeks for further healing of the PD catheter to see if it can be used again without leakage. Collaboration with the patient's surgeon or interventionalist is recommended for this strategy.

A slowly draining PD catheter or one that is positional is an occurrence seen in our incident PD patients regardless of the temporality of their initiation. Best practice is to ensure that constipation is avoided and addressed. Just because bowels were cleared before catheter placement does not mean that they are still cleared. Incomplete evacuation is very common. Fibrin formation as a cause for drain problems is common and often occurs after catheter placement. It can be addressed by using heparin in a ratio of 1000 units per liter of dialysate until it resolves. Finally, a radiograph will offer additional information. The catheter should terminate in the midline over the bladder. If this is not the case, then surgical or interventional manipulation may be needed. Sometimes the catheter will have drainage problems despite radiographic evidence of proper placement and in a patient with normal bowel status. The degree of the problem will have to be weighed against a referral for intervention or observation. Either strategy is a clinical judgment.

*Management of Catheter Dysfunction*

For a patient with severe malfunction of their PD catheter which includes the inability to instill fluid or for a catheter that does not drain at all or minimally, a similar approach arises with the prior scenario of a slowly draining catheter. For a catheter that does not allow dialysate inflow, one can try a syringe push of sterile saline followed by using heparinized dialysate. If that fails then an option is to use tPA as an intracatheter dwell. The quantity to be instilled can be estimated using cooled saline or dialysate. One can slowly advance via a metered syringe the cooled fluid until the patient perceives the fluid reaching their abdomen. This volume can then be instilled as tPA and allowed to dwell for up to an hour and then removed. Failure to improve function at this point requires surgical or interventional assessment. Again, an overpenetrated (high kilovoltage) abdominal flat plate can be obtained to review anatomical position of the catheter. For a catheter that has reasonable inflow but poor or minimal outflow, an omental wrap is a strong clinical concern. This will also prompt a surgical or interventional evaluation assuming the above techniques have failed.

Bleeding can occur after catheter placement and will be immediately obvious with the first drain. This is an uncommon complication with a rate of 0.1 percent for significant hemorrhage in a cohort of 2059 patients. [67] In a hemodynamically stable patient this will typically be from small blood vessel injury within the peritoneum, can usually be managed conservatively, and often will abate. The actual PD procedure will lavage the abdomen. Catheter patency can be promoted by using heparinized dialysate. Follow up hemoglobin measures are important. In the case of sustained bleeding or symptomatic and worsening anemia then admission to the hospital and coordination with the interventionalist or surgeon will be warranted.

Ultimately, catheter malfunctions, exit site leaks and bleeding can almost always be overcome and the patient can remain on peritoneal dialysis.

**Recommendations**

- **RPA endorses the use of PD early starts and urgent starts as an alternative to HD CVC starts.**
- **RPA recommends robust patient education on PD.**
- **RPA believes that the nephrologist and the nephrology team are best poised to guide patients in their decision making about modality of dialysis.**
- **RPA believes that assuring the appropriate infrastructure and clinical setting for urgent PD initiation is essential to success.**

## Abbreviation Glossary

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|---|---|
| APD | automated peritoneal dialysis |
| CAPD | continuous ambulatory peritoneal dialysis |
| CVC | central venous catheter |
| HD | hemodialysis |
| IPP | intraperitoneal pressures |
| IPV | intraperitoneal volumes |
| PD | peritoneal dialysis |
| RRF | residual renal function |
| RRT | renal replacement therapy |
| UF | ultrafiltration |

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**References**


1. Astor BC, Eustace JA, Powe NR, Klag MJ, Fink NE, Coresh J, et al. Type of vascular access and survival among incident hemodialysis patients: the Choices for Healthy Outcomes in Caring for ESRD (CHOICE) Study. J Am Soc Nephrol. 2005;16(5):1449-55.
2. Ishani A, Collins AJ, Herzog CA, Foley RN. Septicemia, access and cardiovascular disease in dialysis patients: the USRDS Wave 2 study. Kidney Int. 2005;68(1):311-8.
3. Lorenzo V, Martn M, Rufino M, Hernández D, Torres A, Ayus JC. Predialysis nephrologic care and a functioning arteriovenous fistula at entry are associated with better survival in incident hemodialysis patients: an observational cohort study. Am J Kidney Dis. 2004;43(6):999-1007.
4. Zipfel PF, Skerka C, Chen Q, Wiech T, Goodship T, Johnson S, et al. The role of complement in C3 glomerulopathy. Mol Immunol. 2015;67(1):21-30.
5. Patel PR, Kallen AJ, Arduino MJ. Epidemiology, surveillance, and prevention of bloodstream infections in hemodialysis patients. Am J Kidney Dis. 2010;56(3):566-77.
6. Mendelssohn DC, Curtis B, Yeates K, Langlois S, MacRae JM, Semeniuk LM, et al. Suboptimal initiation of dialysis with and without early referral to a nephrologist. Nephrol Dial Transplant. 2011;26(9):2959-65.
7. Fluck RF, Fouque D and Lockridge RS. Nephrologist's perspective on dialysis treatment: results of an international survey. BMC Nephrology 2014;15(16): Published online 2014 Jan 15. doi: 10.1186/1471-2369-15-16 PMCID: PMC3912927
8. Machowska A, Alscher MD, Vanga SR, Koch M, Aarup M, Qureshi AR, et al. Offering Patients Therapy Options in Unplanned Start (OPTiONS): Implementation of an educational program is feasible and effective. BMC Nephrol. 2017;18(1):18.
9. Lobbedez T, Lecouf A, Ficheux M, Henri P, Hurault de Ligny B, Ryckelynck JP. Is rapid initiation of peritoneal dialysis feasible in unplanned dialysis patients? A single-centre experience. Nephrol Dial Transplant. 2008;23(10):3290-4.
10. Alkatheeri AA, et al. Success of urgent-start peritoneal dialysis in a large Canadian renal program. Perit Dial Int 36: 171-176, 2016.
11. Blake PG., Jain AK. Urgent Start Peritoneal Dialysis: Defining What it is and Why it Matters. Clin J Am Soc Mephrol 13: 1278-79, 2018.
12. Ghaffari A, et al. Infrastructure requirements for an urgent-start peritoneal dialysis program. Perit Dial Int 33: 611-617, 2013.
13. Ghaffari A. Urgent-Start Peritoneal Dialysis: A Quality Improvement Report. Am J Kidney Dis 59 (3): 400-408, 2012.
14. Crabtree JH, Shrestha BM, Chow KM, Figueirdo AE, Povlsen JV, Wilkie M, Abdel-Aal A, Cullis B, Briggs VR, Browm EA, Dor F. Creating and Maintaining of Optimal Dialysis Access in the Adult Patient:2019 Update. Perit Dial Int September-October 2019 vol. 39 no. 5 414-436.
15. McQuillan RF, Lok CE. Does peritoneal dialysis have a role in urgent-start end-stage kidney disease? Semin Dial. 2018;31(4):325-31.

16. Domenici A, Comunian MC, Fazzari L, Sivo F, Dinnella A, Della Grotta B, et al. Incremental peritoneal dialysis favourably compares with hemodialysis as a bridge to renal transplantation. Int J Nephrol. 2011;2011:204216.
17. Burkart JM, Satko SG. Incremental initiation of dialysis: one center's experience over a two-year period. Perit Dial Int. 2000;20(4):418-22.
18. De Vecchi AF, Scalamogna A, Finazzi S, Colucci P, Ponticelli C. Preliminary evaluation of incremental peritoneal dialysis in 25 patients. Perit Dial Int. 2000;20(4):412-7.
19. Garofalo C, Borrelli S, De Stefano T, Provenzano M, Andreucci M, Cabiddu G, et al. Incremental dialysis in ESRD: systematic review and meta-analysis. J Nephrol. 2019;32(5):823-36.
20. Crabtree JH, Shrestha BM, Chow KM, Figueirdo AE, Povlsen JV, Wilkie M, Abdel-Aal A, Cullis B, Briggs VR, Browm EA, Dor F. Creating and Maintaining of Optimal Dialysis Access in the Adult Patient:2019 Update. Perit Dial Int 2019; 39 (5): 414-36.
21. Gadallah MF, Ramdeen G, Mignone J, Patel D, Mitchell L, Tatro S. Role of preoperative antibiotic prophylaxis in preventing postoperative peritonitis in newly placed peritoneal dialysis catheters. Am J Kidney Dis 2000; 36:1014–9.
22. Helfrich GB, Pechan BW, Alifani MR. Reduction in catheter complications with lateral placement. Perit Dial Bull 1983; 3(Suppl):S2–4.
23. Lovinggood JP. Peritoneal catheter implantation for CAPD. Perit Dial Bull 1984; 4:106–9.
24. Spence PA, Mathews RE, Khanna R, Oreopoulos DG . Improved results with a paramedian technique for the insertion of peritoneal dialysis catheters. Surg Gynecol Obstet 1985; 161:585–7.
25. Stegmayr BG. Paramedian insertion of Tenckhoff catheters with three purse-string sutures reduces the risk of leakage. Perit Dial Int 1993; 13:S124–6.
26. Jo YI, Shin SK, Lee JH, Song JO, Park JH. Immediate initiation of CAPD following percutaneous catheter placement without break-in procedure. Perit Dial Int 2007; 27:179–83.
27. Yang YF, Wang HJ, Yeh CC, Lin HH, Huang CC. Early initiation of continuous ambulatory peritoneal dialysis in patients undergoing surgical implantation of Tenckhoff catheters. Perit Dial Int 2011; 31:551–7.
28. Crabtree JH, Burchette RJ. Effective use of laparoscopy for long-term peritoneal dialysis access. Am J Surg 2009; 198:135–41.
29. Wright MJ, Bel'eed K, Johnson BF, Eadington DW, Sellars L, Farr MJ. Randomized prospective comparison of laparoscopic and open peritoneal dialysis catheter insertion. Perit Dial 1999; 19:372–5.
30. Sharma AP, Mandhani A, Daniel SP, Filler G. Shorter break-in period is a viable option with tighter PD catheter securing during insertion. Nephrology 2008; 13:672–6.
31. Chow KM, Szeto CC, Leung CB, Kwan BC, Pang WF, Li PK. Tenckhoff catheter insertion by nephrologists: open dissection technique. Perit Dial Int 2010; 30:524–7.

32. Kang SH, Do JY, Cho KH, Park JW, Yoon KW. Blind peritoneal catheter placement with a Tenckhoff trocar by nephrologists: a single-center experience. Nephrology 2012; 17:141–7.

33. Crabtree JH, Fishman A, Siddiqi RA, Hadnott LL. The risk of infection and peritoneal catheter loss from implant procedure exit-site trauma. Perit Dial Int 1999; 19:366–71.

34. Prowant BF, Twardowski ZJ. Recommendations for exit care. Perit Dial Int 1996; 16:S94–9.

35. Casaretto A, Rosario R, Kotzker WR, Pagan-Rosario, Groenhoff C, Guest S. Urgent-Start Peritoneal Dialysis: Report of a U.S. Private Nephrology Practice. Advances in Peritoneal Dialysis. 2012;28:102-105.

36. Ghaffari A. Urgent-Start Peritoneal Dialysis: A Quality Improvement Report. Am J Kidney Dis. 2012;59(3):400-408. doi.org/10.1053/j.ajkd.2011.08.034

37. Jo YI, Shin SK, Lee JH, Song JO and Park JH. Immediate Initiation of CAPD f\Following Percutaneous Catheter Placement Without Break-In Procedure. Peritoneal Dialysis International 2006;27:179-183.

38. Liu S, Zhuang X, Zhang M, Wu Y, Liu M, Guan S, Liu S, Miao L and Cul W. Application of Automated Peritoneal Dialysis in Urgent-Start Peritoneal Dialysis Patients During the Break-in Period. International Urology and Nephrology. 2018; 50: 541-549. doi.org/10.1007/s11255-018-1785-1

39. Povlsen JV and Ivarsen P. How to Start the Late Referred ESRD Patient Urgently on Chronic APD. Nephrol Dial Thransplant. 2006; 21 (Suppl 2): ii56-ii59. doi:10.1093/ndt/gfl192

40. Wang C, Fu X, Yang Y, Deng J, Zhang H, Deng H, Lu J, Peng Y, Liu H, Liu F and Liu Y. A Comparison Between Intermittent Peritoneal Dialysis and Automatic Peritoneal Dialysis on Urgent Peritoneal Dialysis. American Journal of Nephrology. 2017; 45:540-548. DOI: 10.1159/000477178

41. Liu Y, Zhang L, Lin A, Ni Z, Qian J and Fang W. IMPACT OF BREAK-IN PERIOD ON THE SHORT-TERM OUTCOMES OF PATIENTS STARTED ON PERITONEAL DIALYSIS. Perit Dial Int 2014; 34(1):49–56. doi: 10.3747/pdi.2012.00293

42. Koch M, Kohnle M, Trapp R, Haastert B, Rump LC and Aker S. Nephrol Dial Transplant. 2012; 27: 375–380. doi: 10.1093/ndt/gfr262

43. Ghaffari A, Kumar V, and Guest S. Infrastructure Requirements for an Urgent-Start Peritoneal Dialysis Program. Perit Dial Int 2013; 33(6):611-617. doi: 10.3747/pdi.2013.00017

44. Dejardin A, Robert A, and Goffin E. Intraperitoneal pressure in PD patients: relationship to Intraperitoneal volume, body size and PD-related complicaitons. Nephrol Dial Transplant (2007) 22: 1437–1444

45. Diaz VP, Ballesteros SS, et.al. Intraperitoneal pressure in peritoneal dialysis. Nefrologia. 2017;37:579–586.

46. Twardowski ZJ, Prowant BF, Nolph KD, Martínez AJ, Lampton . LM. High volume, low frequency continuous ambulatory peritoneal dialysis. Kidney Int. 1983;23:64–70.

47. Twardowski ZJ, et al. Peritoneal Equilibration Test. Perit Dial Int. 1987;7(3):138-148

48. Mujais S, Vonesh E. Profiling of peritoneal ultrafiltration. Kidney Int Suppl. 2002;(81):S17-S22

49. Van Biesen W, Heimburger O, et.al. Evaluation of peritoneal membrane characteristics: a clinical advice for prescription management by ERBP working group. Nephrol Dial Transplant (2010) 25: 2052–2062

50. National Kidney Foundation. KDOQI Clinical Practice Guidelines and Clinical Practice Recommendations for 2006 Updates: Hemodialysis Adequacy, Peritoneal Dialysis Adequacy and Vascular Access. Am J Kidney Dis 48:S1-S322, 2006 (suppl 1).

51. Wang AY, Lai KN: The importance of residual renal function in dialysis patients. Kidney Int 2006;69:1726-1732.

52. Marrón B, Remón C, Pérez-Fontán M, Quirós P, Ortíz A: Benefits of preserving residual renal function in peritoneal dialysis. Kidney Int Suppl 2008;108:S42-S51.

53. Bargman JM, Thorpe KE, Churchill DN, et al. Relative contribution of residual renal function and peritoneal clearance to adequacy of dialysis: a reanalysis of the CANUSA study. J Am Soc Nephrol 2001; 12: 2158–2162

54. Li PK, Chow KM, Wong TY, Leung CB, Szeto CC. Effects of an angiotensin-converting enzyme inhibitor on residual renal function in patients receiving peritoneal dialysis. A randomized, controlled study. Ann Intern Med. 2003;139(2):105–12.

55. Suzuki H, Kanno Y, Sugahara S, Okada H, Nakamoto H. Effects of an angiotensin II receptor blocker, valsartan, on residual renal function in patients on CAPD. Am J Kidney Dis. 2004;43(6):1056–64.

56. Shen JI, Saxena AB, Montez-Rath ME, Chang TI, Winkelmayer WC. Angiotensin-converting enzyme inhibitor/angiotensin receptor blocker use and cardiovascular outcomes in patients initiating peritoneal dialysis. Nephrol Dial Transplant. 2017;32:862–9.

57. Htay H, Johnson DW, Wiggins KJ, Badve SV, Craig JC, Strippoli GFM, Cho Y. Biocompatible dialysis fluids for peritoneal dialysis. Cochrane Database of Systematic Reviews 2018, Issue 10. Art. No.: CD007554. DOI: 10.1002/14651858.CD007554.pub3

58. Jansen MA, Hart AA, Korevaar JC, Dekker FW, Boeschoten EW, Krediet RT; NECOSAD Study Group: Predictors of the rate of decline of residual renal function in incident dialysis patients. Kidney Int 2002;62:1046-1053.

59. Davies SJ, Davenport A: The role of bioimpedance and biomarkers in helping to aid clinical decision-making of volume assessments in dialysis patients. Kidney Int. 2014; 86: 489–496.

60. van Olden RW, Guchelaar HJ, Struijk DG, et al. Acute effects of high-dose furosemide on residual renal function in CAPD patients. Perit Dial Int 2003; 23: 339–347

61. Medcalf JF, Harris KP, Walls J. Role of diuretics in the preservation of residual renal function in patients on continuous ambulatory peritoneal dialysis. Kidney Int 2001; 59: 1128–1133

62. Liu X, Dai C: Advances in Understanding and Management of Residual Renal Function in Patients with Chronic Kidney Disease. Kidney Dis 2016;2:187-196. doi: 10.1159/000449029

63. Shen JI, Saxena AB, Vangala S, Dhaliwal SK, Winkelmayer WC. Renin-angiotensin system blockers and residual kidney function loss in patients initiating peritoneal dialysis: an observational cohort study. BMC Nephrol. 2017;18(1):196. doi:10.1186/s12882-017-0616-4

64. Bieber SD, Burkart J, Golper TA, Teitelbaum I, Mehrotra R. Comparative outcomes between continuous ambulatory and automated peritoneal dialysis: a narrative review. Am J Kidney Dis. 2014;63(6):1027–1037. doi:10.1053/j.ajkd.2013.11.025

65. Mehrotra R, Devuyst O, Davies SJ, Johnson DW. The Current State of Peritoneal Dialysis. J Am Soc Nephrol. 2016;27(11):3238–3252. doi:10.1681/ASN.2016010112

66. Xu D, Liu T, Dong J. Urgent-start peritoneal Dialysis complications: prevalence and risk factors. Am J Kidney Dis. 2017;70(1):102–110. doi: 10.1053/j.ajkd.2016.12.021.

67. Ye H, Yang X, Yi C, Guo Q, Li Y, Yang Q, Chen W, Mao H, Li J, Qiu Y, Zheng X, Zhang D, Lin J, Li Z, Jiang Z, Huang F, Yu X. Urgent-start peritoneal dialysis for patients with end stage renal disease: a 10-year retrospective study. BMC Nephrol. 2019; 20(1):238.

68. See EJ, Cho Y, Hawley CM, Jaffrey LR, Johnson DW. Early and Late Patient Outcomes in Urgent-Start Peritoneal Dialysis. Perit Dial Int. 2017 Jul-Aug:37(4):414-419.

69. Wang AY-M. et al. The importance of residual renal function in dialysis patients. Kidney Int. 2006; 69 (10): 1726 – 1732.

70. Javaid MM, Khan BA, Subramanian, S. Peritoneal dialysis as initial dialysis modality: a viable option for late-presenting end-stage renal disease. J Nephrol. 2019; 32: 51–56. https://doi.org/10.1007/s40620-018-0485-3