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Sophia L. Ambruso, Isaac Teitelbaum

Prevention of Peritoneal Dialysis Drop-Out

Compared with hemodialysis (HD), peritoneal dialysis (PD) is associated with reduced cost and improved quality of life. But despite those benefits, PD represents a small percentage of the renal replacement therapy performed. Although a number of factors contribute to that situation, peritoneal drop-out is a complex issue that leads to as much as a 35% annual transition from PD to in-center HD. The reasons for drop-out are multifaceted and include contributions from the patient or caregiver, health care regulatory systems, and factors intrinsic to the PD modality. In this review, we focus on specific causes of PD drop-out and on prevention and intervention strategies that can improve success and duration on PD.

Key words
Drop-out, technique failure

Introduction

Peritoneal dialysis (PD) has been in use for the treatment of end-stage renal disease for more than 35 years. When used as an initial modality in end-stage renal disease patients, PD, compared with in-center HD, has been associated with preservation of residual kidney function and improved survival (1). In addition, PD has been shown to be more cost-effective and to offer improved satisfaction, autonomy, and quality of life (2). Interestingly, a survey of practicing nephrologists listed PD as the preferred initial renal replacement therapy for the patient (3). And yet, despite the documented benefits and reported physician preference, PD accounts for only 10% – 11% of the total renal replacement therapy performed annually. Despite more autonomy and better quality of life in PD patients compared with HD patients, major challenges have attenuated the success of PD. Notable among those challenges is technique failure, which is responsible for as much as a 35% annual rate of patient transition from PD to in-center HD (4).

The first 6 – 12 months are critical with respect to PD drop-out (4). When death and transplantation are included in the analysis, 40% of PD drop-out occurs within the first 3 months and 25% occurs between months 3 and 12 (4,5). Catheter-related complications are the largest contributor to PD discontinuation in the first 90 days. Between 3 and 12 months, infectious complications and psychosocial reasons account for the greatest percentage of transfer to in-center HD. Proper patient selection, strong social support, and patient education are necessary for early PD success. However, it is important to point out that although predicting early complications and subsequent drop-out is difficult, rapid recognition and intervention are necessary when such complications occur. Sadly, after a switch to HD, the rate of return to PD is low, and its probability declines as time on HD increases, as highlighted by Lan *et al.* (6), whose study demonstrated that 24% of patients return to PD after 30 days on HD, but that only 3% return to PD after 180 days. Here, we review the major causes of PD technique failure and discuss potential methods for preventing such failures.

Discussion

Catheter-related complications

Catheter related complications—including blockage (for example, because of constipation, full bladder, fibrin accumulation, adhesions, omental wrap), misplacement, and displacement or migration—account for a high percentage of early PD drop-out. Obstruction, migration, or displacement of the catheter might be unavoidable; correction depends on prompt recognition and intervention by the health care team.

The most common causes of catheter occlusion are constipation or a full bladder. Those causes can be corrected with laxatives or increased frequency of bladder emptying. Fibrin clots, if identified early, are often easily addressed with intracatheter administration of heparin or tissue plasminogen activator. Correction of omental wrapping and adhesions usually

From: Division of Hypertension and Renal Diseases, University of Colorado–Denver, Aurora, Colorado, U.S.A.

requires surgical intervention; that need for surgery should not dissuade physicians and patients from pursuing PD. Laparoscopic interventions such as omentopexy, resection of epiploic appendices, and lysis of adhesions and the like can be very effective in ensuring long-term PD success. Early recognition and intervention can salvage many PD catheters, often without interrupting PD.

Infectious complications

Great strides have been made in the overall reduction of PD drop-out by reducing the rate of PD peritonitis (7). Infectious complications—including PD peritonitis, exit-site infections (ESIs), tunnel infections, and secondary peritonitis—account for 28% of transfers from PD to HD. Historically, the use of twin bags and Y-set tubing systems with flush-before-fill has helped to reduce the peritonitis risk (8). However, other catheter-related interventions, including access site selection and mode of placement have not achieved statistically significant reductions in infectious complication rates. Still, anecdotal evidence suggests that proper catheter placement by an experienced surgeon helps in exit-site visualization, ensuring better catheter care (8).

Transluminal infection by touch contamination and environmental exposure account for 35% of PD peritonitis episodes. In early studies pre-dating topical antimicrobial therapy for the catheter exit site, nasal carriers of *Staphylococcus aureus* experienced a higher rate of *S. aureus* ESIs (9). Because most catheter-related infections are attributable to the patient or the caregiver, patient education and catheter care are paramount in preventing PD peritonitis. Hand hygiene has been demonstrated to dramatically reduce the degree of translocation after touch contamination. The International Society for Peritoneal Dialysis recommends the use of a topical antibiotic intranasally or at the catheter exit. Topical application of an antimicrobial to the catheter exit has been shown to reduce the rates of ESI and peritonitis. Gentamicin is preferred to mupirocin for reducing the risk of both *S. aureus* and *Pseudomonas* ESIs (10). Consistent and diligent daily inspection, cleansing, and disinfection of the exit site is most important. Implementation of protocols reinforcing the importance of exit-site care and frequent screening for early identification of, and intervention for, poor technique and signs of infection are warranted to ensure success.

Volume overload and decreased solute clearance

Combined, volume overload and inadequate solute clearance account for approximately 18% of all PD failures. Failure to maintain adequate volume status is attributable mainly to high salt or fluid intake, inadequate dialysis prescription, and failure to adjust the dialysis prescription as residual kidney function (RKF) is lost. True ultrafiltration failure (UFF) is rare. Its pathogenesis is multifaceted. Uremia, infectious peritonitis, high glucose concentrations, the presence of glucose degradation products, and the generation of advanced glycation endproducts are believed to lead to chronic inflammation, angiogenesis, and fibrosis, thus structurally altering the peritoneal membrane over time and leading to membrane failure. As that change occurs, the rate of solute transfer increases, more rapidly dissipating the osmotic gradient and necessitating increased dextrose concentrations. Increased dextrose concentrations are thought to contribute to membrane failure and can be problematic in individuals with diabetes. The use of icodextrin, a glucose polymer not readily absorbed by the peritoneum, has been beneficial in reducing PD drop-out. Unfortunately, not all PD programs have icodextrin available. In those that do not, the occurrence of UFF is thought to be greater. Older studies reporting a high rate of UFF (30%–50%) and transition to HD (24%) were not making use of icodextrin (11). With the advent of icodextrin, a more modest estimate of UFF ranges between 1.7% and 13.7% (12).

Prevention strategies must be centered on fluid and salt restriction and maintenance of dry weight. In patients with good RKF, loop diuretics are a useful adjunct in maintaining dry weight while avoiding higher dextrose loads. High doses of those diuretics are often needed and should be used liberally; the risk for ototoxicity is very small. Initial and continuous counseling about compliance with dietary and fluid restrictions is helpful. Attempts at preserving RKF by avoiding nephrotoxins and situations that would increase the risk of dehydration and hypotensive episodes remain useful. Repeated or prolonged episodes of in-center HD have been shown to contribute to loss of RKF, and avoidance of such treatments is preferred, if possible. If loss of RKF does occur, frequent monitoring with close attention to volume status, small-solute clearance, and signs of uremia are important to allow for early intervention. Switching to a cycler, changes in the duration or frequency of dwells (or both), and the addition of icodextrin to the prescription are often useful to achieve adequacy and volume control.

The use of angiotensin converting-enzyme inhibitors should be encouraged, because those agents confer several benefits to the PD patient: preservation of RKF and a slowing of the transition to more rapid transport status. As previously discussed, icodextrin is a good alternative or adjunct to a PD prescription, permitting effective ultrafiltration while minimizing glucose load. In addition, icodextrin has been shown to slow the rate of RKF loss and to reduce the rate of membrane function decline, thereby achieving greater ultrafiltration and sodium removal (13). Early data suggest that biocompatible PD fluids such as glucose-free PDF and bicarbonate-buffered fluids low in glucose degradation products will preserve the peritoneal membrane. However, those solutions are expensive and not yet widely available (14).

Inadequate solute clearance is rarely the result of a true inability to obtain sufficient solute clearance and avoid uremic symptoms. In most patients who experience "inadequate" small-molecule clearance, lack of clearance is associated with insufficient dialysis relative to the patient's size or loss of RKF (or both). Switching to a cycler, changing the frequency or duration of dwells, or adding an extra daytime dwell are usually effective at accomplishing a Kt/V of 1.7 or greater. However, patient reluctance, schedule limitations, dietary indiscretions, or a lack of comfort or inexperience on the part of the prescribing physician can hinder success. Lastly, there is a population of patients who cannot achieve a Kt/V of 1.7, but who continue to thrive without uremic signs or symptoms. Unfortunately, based on regulations established by governments or large dialysis organizations, such patients might arbitrarily be switched to HD without consideration of clinical success. Switches of that kind should be strongly discouraged. With respect to both volume overload and solute clearance, the experience and comfort of the prescribing physician provide greater flexibility and confidence to individualize therapy and problem-solve with the more challenging patient cohort.

Defects of the peritoneal boundary (leaks and hernias)

Hydroceles, peritoneopleural leaks, and hernias are often unavoidable. Success of PD with hydroceles, either acquired or attributable to a patent processus vaginalis, is often limited by patient comfort. Surgical correction with brief discontinuation of PD (not necessitating interim HD) is generally feasible. Peritoneopleural leaks are associated with a greater risk of morbidity and mortality, and generally lead to appropriate and permanent transition to HD. Hernias, however, have been shown to be less problematic and play a minimal role in PD drop-out. In contrast, pericatheter leaks carry an increased risk of PD peritonitis and, if persistent, should be managed surgically, with new catheter placement if needed.

Psychosocial, economic, and medical causes

Certain non-modifiable socioeconomic risk factors place a patient at higher risk for PD drop-out. Shen *et al.* (15) demonstrated that full-time employment is protective and that patients in retirement or on disability have a higher rate of technique failure, suggesting that those who are healthy enough to maintain full-time jobs are also more independent, with stable home environments. Patients on Medicaid experience higher rates of modality failure, suggesting that individuals with lower socioeconomic status have reduced access to care. Lower levels of education are a major independent risk for PD-related peritonitis and subsequent PD drop-out (16).

Change in employment or new responsibilities at home (for example, a sick family member) can drastically alter a patient's schedule, making PD seem inconvenient—particularly if the prescribing physician is less comfortable with unconventional PD schedules. Having a stable home environment is a necessity for long-term PD success, particularly for patients dependent on a family member or caregiver. Death of the caregiver or a change in living situation can prevent a thriving patient from continuing with PD. Peritoneal dialysis units should be able to provide respite care for 1 – 2 weeks, freeing the patient or caregiver from the burdens of daily care.

Certain interventions can reduce PD drop-out attributable to psychosocial factors. An emphasis on patient education and the availability of frequent psychosocial support can allow for early recognition and intervention. Experience of the prescribing physician expands the degree of comfort in prescribing unconventional PD regimens when schedule conflicts are prohibitory. Assisted PD has been shown to reduce the risk of PD transfer and could become a more plausible alternative when physical incapacity or changes in the patient's living situation prevent ongoing PD (17).

Role of facility size

In countries with limited HD access, where PD is supported by the government, the prevalence of PD is higher and the rate of drop-out is lower. In Hong Kong, where HD is less prevalent, PD units are much larger in size, and staff members are very experienced. Not surprisingly, a 2-year PD drop-out rate of only 18% is reported (18). Huisman *et al.* (19) also demonstrated that center size matters: having fewer than 20 patients on PD is associated with a drop-out rate exceeding 35%. In addition, those authors showed that the fraction of patients on PD varied with the attitude of the physicians and nursing staff toward PD. Additional studies showed that PD mortality decreases as center size and the number of PD patients treated increase (7). Plantinga *et al.* (20) demonstrated that dialysis units treating more than 50 patients had lower risk of PD transfer to in-center HD and a reduced cumulative incidence of cardiovascular events. Furthermore, larger units are optimized to identify patients at risk for fatigue and burnout, and to appropriately counsel them. In addition, such units are better equipped to provide temporary respite for caregivers using avenues such as in-unit daytime PD to briefly alleviate some of the PD burden. Because the United States has greater HD accessibility, fewer patients receive PD, and the units tend to be smaller. Thus, PD exposure for practicing physicians, training fellows, and ancillary staff is limited.

The experience and comfort of PD physicians, nurses, and ancillary staff with PD is paramount in making use of prevention strategies and interventions to circumvent PD drop-out. In particular, greater experience with patient selection, social support, patient education and training, catheter surveillance, and prescription modification will help in the early recognition of risk factors and timely implementation of appropriate preventive strategies and interventions. Until PD becomes more widely used in the United States and elsewhere, reaching those goals could be challenging. A possible solution involves consolidating the many smaller PD units within a region into larger, dedicated centers—an approach that has not been put into regular practice. From an educational standpoint, renal fellowships with low PD volumes might consider contracting with non-program-associated PD units for greater access to PD patients. Various home dialysis conferences are available and are heavily promoted in fellowship programs, but experience and physician comfort remain a problem. With experience comes the confidence to individualize therapy and to problem-solve for challenging PD patients.

Summary

Although unavoidable reasons for PD drop-out will persist, numerous avenues to reduce the burden of PD drop-out are available. Patient selection remains important in identifying those at greatest risk for PD drop-out and in making sound decisions about who will achieve success on PD. A dedicated and experienced PD team—including prescribing physicians, nursing staff, and support staff—is necessary for implementing protocols that will assist with early and ongoing screening for PD drop-out risk factors and early implementation of prevention strategies. In addition, initial and ongoing efforts to educate patients and caregivers will reduce the risk of PD failure arising from certain avoidable causes. Comfort on the part of the prescribing physician in troubleshooting difficult patients and a willingness to pursue unconventional techniques to achieve dialysis adequacy will be beneficial for ongoing PD success. Lastly, strong social support and attempts to recognize those at highest risk for burnout—patients and caregivers alike—could reduce early transition off PD. Achieving such support requires experience, which large PD units make possible. In countries in which the use of PD is lower, a possible solution would be to consolidate many smaller PD units within a region into larger, dedicated centers. Optimizing all of the foregoing practices will reduce drop-out and maximize a patient's probability of success on PD.

Disclosures

We understand that *Advances in Peritoneal Dialysis* requires disclosure of any conflicts of interest, and we declare that we have no conflicts to disclose.

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Corresponding author:
Isaac Teitelbaum, MD, 12605 E 16th Avenue, Anschutz Inpatient Pavilion, 1st floor, Aurora, Colorado 80045 U.S.A.
E-mail:
Isaac.teitelbaum@ucdenver.edu