# Peritoneal Dialysis in Patients with Abdominal Surgeries and Abdominal Complications

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*Peritoneal dialysis (PD) is an excellent treatment option for the patients with end-stage renal disease, having been shown to yield improved patient satisfaction and economic benefit. Many surgeons and physicians believe that patients with prior abdominal surgeries or other abdominal complications are not viable candidates for PD and that prevalent PD patients needing abdominal surgery should be switched to hemodialysis. The purpose of the present review is to address those misconceptions.*

*Our review of literature shows that, when appropriately planned, PD can still be an acceptable option for patients with end-stage renal disease and certain abdominal complications, including abdominal surgery, provided that the peritoneum is not compromised. Anticipating complications—and changing the PD prescription accordingly—can allow many such patients to continue PD without any interruption, thus maintaining their lifestyle and avoiding an increase in medical expense.*

**Key words**
Abdominal surgery, abdominal complications

## Introduction

Peritoneal dialysis (PD) is a common form of renal replacement therapy for end-stage renal disease patients. Many studies have shown improved mortality and better patient satisfaction among patients undergoing PD. Vonesh *et al.* (1) observed 398,940 dialysis patients between 1995 and 2000. They found that the adjusted mortality rate was the same or higher for hemodialysis (HD) compared with PD in most patient groups, excepting only older patients with diabetes. Similarly, Heaf and colleagues (2) found a significant mortality benefit for PD compared with HD during the first 2 years after dialysis initiation. In a similar study, Weinhandl *et al.* (3) paired 6337 HD and PD patients, matching them by propensity score, and found that the death risk was 8% lower for patients who, on day 0 of end-stage renal disease, were started on PD compared with those who were started on HD. In 2011, Mehrotra *et al.* (4) also demonstrated a reduction in the adjusted relative risk of death in patients starting PD treatment compared with those starting HD.

Many studies have also shown that psychological satisfaction is improved for PD compared with HD. The CORETH study looked into dialysis modalities and treatment satisfaction. It showed that, compared with HD patients, PD patients were more satisfied with their treatment and had a more autonomy-seeking personality (5). Similarly, Fadem *et al.* (6) demonstrated that, compared with patients receiving in-center HD, patients on any kind of home dialysis, including home HD or PD, report better satisfaction. The many advantages of PD over HD include an opportunity for home dialysis, with a flexible schedule that provides the opportunity to travel; better preservation of residual renal function; lower health care costs; greater patient satisfaction; and fewer episodes of sepsis and bacteremia (7,8). Based on the foregoing studies and observations, Chaudhary *et al.* (9) in 2011 recommended that, when feasible, PD should be offered as the first-line dialysis modality.

The success of PD depends on patient selection. Many physicians believe that patients with prior abdominal surgeries and other abdominal complications are not suitable candidates for PD. Similarly, it is also a common belief that patients on PD who

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require abdominal surgery also require temporary or permanent transition to HD. In 2016, Lee *et al.* (10) described many of the misconceptions that lead to early termination of PD, with increased expenses for HD and compromised quality of life for the affected patients.

The purpose of the present review article is therefore to discuss the impact of various abdominal complications, including abdominal surgeries, in the PD population and to clarify the related misconceptions. Peritoneal dialysis is a very effective, inexpensive, and safe form of renal replacement therapy. Whenever possible, interruption or early termination should be avoided.

## Discussion

### *PD in patients with feeding tubes*

Protein malnutrition is common in patients on PD for two reasons: low dietary protein-calorie intake, and protein loss through PD. Low serum albumin in PD patients is the single most important predictor of increased mortality (11). The placement of a feeding tube to provide nutrition, when appropriate, benefits certain patients.

In 1999, Ramage *et al.* (12) assessed the efficacy of placing feeding gastrostomy tubes (G-tubes) in infants and children. A G-tube was placed in 15 patients receiving PD. Tube feeds facilitated weight gain in infants and children without any adverse effect on PD treatment. An increase in serum total protein and albumin was also noted. None of the patients experienced an episode of peritonitis.

Later, in 2001, Fein *et al.* (13) assessed the outcome of percutaneous endoscopic G-tube (PEG) placement in 10 adult patients on PD. Of those 10 patients, 2 had a functioning PEG at the start of dialysis, and no complications were reported after the start of the PD. The other 8 patients were already on PD when the PEG was inserted. Of those 8 patients, 6 were switched to HD. The other 2 continued on PD, but both developed peritonitis. The authors concluded that placement of a feeding G-tube before PD initiation is safe, but that placement after PD initiation is associated with multiple complications.

Similarly, in 2002, Ledermann *et al.* (14) observed 29 children on PD with a G-tube. In 15 children, a G-tube was placed by percutaneous gastrostomy, by Nissen fundoplication and gastrostomy, or by open gastrostomy before PD start. In another 9 children, a G-tube was placed by Nissen fundoplication and gastrostomy or by open gastrostomy after the start of PD, and in 5 children, a PEG was placed after the start of PD. The authors documented multiple episodes of peritonitis in children whose G-tube was placed after dialysis initiation. They therefore recommended G-tube placement before PD initiation.

Recently, in 2015, Prestidge *et al.* (15) observed 17 children who had a G-tube placed either while on PD or before PD start, which occurred within 72 hours of G-tube placement. The incidence of peritonitis (episodes/patient–year at risk) in patients who started PD before G-tube placement was 0.6; in those who started PD after G-tube placement, it was 0.121. Given the small number of patients in the study, the *p* value was nonsignificant. However, considering the almost doubled incidence of peritonitis in patients whose G-tube was placed after PD initiation, the study result accords with earlier observations of an increased incidence of infections in PD patients who had a G-tube placed after PD initiation.

Dahlan *et al.* (16) reported the case of a 79-year-old woman on PD who had a feeding G-tube placed and was switched to HD. She received prophylactic oral fluconazole and intravenous piperacillin–tazobactam. Unfortunately, she developed a leak at the G-tube site. Later, her peritoneal fluid grew multiple bacterial and fungal species, including *Klebsiella oxytoca, Pseudomonas aeruginosa, Enterococcus* species, and *Candida albicans.*

These limited case series and the case report indicate that placement of a PD catheter in patients with a pre-existing G-tube is usually safe, but insertion of a G-tube in patients already on PD can be associated with major adverse outcomes, including leaks and episodes of peritonitis (Tables I and II). Residual peritoneal fluid might prevent effective healing of the G-tube site, with subsequent spillage of gastric contents into the peritoneal space, inducing peritonitis (16). Withholding PD, switching to HD, and using prophylactic antimicrobials might lower the incidence of peritonitis associated with G-tube insertion in patients on PD. It is not clear whether surgical (as opposed to endoscopic) placement of a G-tube provides any benefit in preventing leaks or episodes of peritonitis.

### *PD in patients with diverticular disease of the colon*

Clinicians might be reluctant to offer PD to patients with colon diverticulosis, because of a theoretical

increase in the risk of peritonitis (17,18). In diverticulosis, loss of intestinal wall integrity because of the absence of a muscular layer in the diverticula increases the chances of enteric peritonitis stemming from inflammation or obstruction of the diverticula.

In 1990, Tranæus *et al.* (19) used barium enema to assess 129 patients at start of PD. Of those patients, 42% were found to have more than 1 diverticulum, with 23% of that group experiencing peritonitis with enteric flora. The authors suggested that peritonitis episodes in PD patients can be assigned to one of three categories:

- Peritonitis from external contamination (mainly gram-positive organisms)
- Peritonitis from diverticular perforation (multiple gram-negative organisms)
- Peritonitis from a microperforation of a diverticulum (mainly a single gram-negative organism)

That categorization is helpful in determining the choice of antibiotics for treatment. The risk factors significant for the development of peritonitis in that study were a number of diverticula exceeding 10; diverticula size exceeding 10 mm; diverticula found in the ascending, transverse, or descending colon (but not in the sigmoid colon).

An increase in the number or size of diverticula places patients at higher risk of microperforations. Although the ascending and descending portions of colon are retroperitoneal structures, their presence in the abdominal cavity makes any diverticula in them potential sources for peritonitis. Similarly, being that the transverse colon is both an intraperitoneal and an abdominal structure, diverticular disease in that portion is associated with a greater risk of peritonitis. Even if affected by diverticular disease, the sigmoid colon, being located in the pelvis and being retroperitoneal, is not associated with an increased risk of peritonitis.

Yip *et al.* (20) evaluated 604 PD patients for diverticulosis by colonoscopy or barium enema. Of those patients, 24% were found to have diverticulosis, with the most common site being the ascending colon, and the organism most frequently associated with peritonitis being *Escherichia coli.* The investigators concluded that the presence of diverticulosis is an independent risk factor for the development of enteric peritonitis.

In general, PD is safe for patients who have diverticulosis (Tables III and IV). Episodes of diverticulitis that cause inflammation of the bowel wall theoretically lead to higher risk of translocation of organisms across the bowel wall into the peritoneal cavity. No clear evidence has been developed to show whether holding PD during an attack of diverticulitis lessens the risk of bacterial translocation, but holding PD could be considered in patients who have sufficient residual renal function. A history of recurrent diverticulitis is a concern when considering PD as a possible renal replacement therapy.

TABLE I Complications associated with gastrostomy tube insertion in patients on peritoneal dialysis

| | |
|---|---|
| 1. | Gastrostomy tube leak |
| 2. | Recurrent episodes of peritonitis |
| 3. | Increased risk of multi-organism peritonitis |
| 4. | Increased risk of fungal peritonitis |

TABLE II Steps to prevent adverse effects from insertion of gastrostomy tube in patients on peritoneal dialysis

| | |
|---|---|
| 1. | Switch to hemodialysis for a short time for insertion of the gastrostomy tube |
| 2. | Prophylactic use of antimicrobial agents |
| 3. | Prophylactic use of antifungal agents |

TABLE III Risks for peritonitis in patients with diverticulosis receiving peritoneal dialysis (19)

| | |
|---|---|
| 1. | Location of diverticula (ascending, transverse, or descending colon) |
| 2. | More than 10 diverticula |
| 3. | Size of diverticula exceeding 10 mm |
| 4. | Recurrent episodes of diverticulitis |

TABLE IV Potential risks of peritoneal dialysis in any patient

| | |
|---|---|
| 1. | Peritoneal fluid leak |
| 2. | Hernia |
| 3. | Increased diverticular disease, with potential for peritonitis, in patients with polycystic kidney disease |
| 4. | Vascular aneurysm |
| 5. | Increased incidence of infection |

*PD in patients with polycystic kidney disease*

Many physicians believe that PD is contraindicated in patients with polycystic kidney disease (PKD). Extrarenal manifestations of PKD, such as an increased incidence of diverticulosis, vascular aneurysms, and development of hernias, remain a theoretic risk in patients on PD. Similarly, increased kidney size can compromise the size of the abdominal cavity and thus can theoretically affect the efficacy of PD. The increased risk of infection in patients with PKD has an unknown effect on the risk of peritonitis in patients receiving PD.

In 2011, a report from the French PD registry evaluated 344 patients with PKD who were receiving PD. No significant association between PKD and PD technique failure was observed. Further, no significant association between PKD and peritonitis or between PKD and enteric peritonitis was evident (21). Another study from Taiwan's national health insurance research database evaluated patients with PKD receiving PD and compared them with PD patients who did not have PKD. No differences in peritonitis or major hospitalization was found between the two groups (22).

Other studies have shown that PD, as renal replacement therapy, is not associated with an increase in the overall risk of technique failure or infectious peritonitis in patients with PKD compared with patients not having PKD. Mortality was also not different between the two groups (23,24).

Based on these multiple studies, it can be concluded that PD can safely be performed in patients with PKD. A slight increase is seen in the rates of leak and hernia, but long-term outcomes are, overall, comparable to those in nondiabetic PD patients.

*PD in patients with abdominal hernia*

Abdominal hernia can be significant problem in PD patients, affecting 12% – 37% of patients in published series (25–27). The intraperitoneal pressure (IPP) of the peritoneal cavity averages 8.3 ± 3.3 cm $H_2O$ when drained and 13.5 ± 3.3 cm $H_2O$ with a fill volume of 2 L. The IPP increases linearly by 1.33 ± 0.44 cm $H_2O$ for each 500 mL of additional infused volume, independent of the initial IPP (28). That increase in IPP increases the risk that an abdominal hernia will occur. Table V describes the factors associated with the increased risk of hernia in patients on PD (25).

In 2003, Balda *et al.* (29) assessed the effect of hernias and their surgical or conservative management in patients on PD. In that study, the most common hernias in the PD population were umbilical hernias, followed by inguinal, incisional, and epigastric hernias. The data showed that hernia recurrence rates were low, and that PD technique survival was not negatively affected.

TABLE V Factors associated with increased risk of hernia development in patients on peritoneal dialysis

| | |
|---|---|
| 1. | Previous history of abdominal hernias |
| 2. | Patent processus vaginalis |
| 3. | Midline peritoneal dialysis catheter placement |
| 4. | Constipation in the postoperative period |
| 5. | Excessive cough in the postoperative period |
| 6. | Advanced age |
| 7. | High body mass index |
| 8. | Polycystic kidney disease |

In 2011, Wakasugi *et al.* (30) assessed 9 PD patients with abdominal hernias. All patients underwent hernia repair without switching to HD. The surgical procedure was performed with mesh placement in all cases. No patient experienced a surgical complication, including recurrence of hernia or a leak. The rate of mesh infection in PD patients is unknown.

Various surgical approaches have been used for mesh repairs. Theoretically, the infection risk is greater with intraperitoneal mesh placement, but randomized controlled trials comparing the various surgical approaches are lacking. Neo-epithelization of mesh, forming a barrier against infection, takes up to 4 weeks. Thus, it would be prudent to delay PD or to transfer the patient to HD for 4 weeks after an intraperitoneal mesh placement (Tables VI and VII).

Sodo *et al.* (31) published their 6-year experience with repair of various types of abdominal hernias and simultaneous placement of a PD catheter. During a mean follow-up of 551 days, no hernia recurrence was registered, and PD was continued without any problem. There was also no reported case of peritonitis.

Based on their clinical experience and a literature review, Khoury *et al.* (32) recommended

- careful initial examination before placement of the PD catheter to rule out any type of hernia.
- periodic abdominal examination after insertion of the PD catheter.
- elective hernia repair before initiation of PD.

- bilateral hernia repair for any young male patient with an inguinal hernia on one side.

It is also reasonable to check for a patent processes vaginalis at time of PD catheter insertion, with elective closure before initiation of PD.

*PD and renal surgeries*

End-stage renal disease puts patients at higher risk of urologic carcinoma. The treatment for such cancers is radical nephrectomy. When the cancer is large in size, an anterior approach, which can compromise the peritoneum, is often used. Similarly, because of the large size of the kidneys, nephrectomy for PKD cannot be accomplished by the retroperitoneal route; it is usually done using an anterior approach, which compromises the peritoneum, rendering it ineffective for PD (Table VIII).

Just a few case reports have described nephrectomy in patients on PD or PD initiation in patients who have undergone nephrectomy.

Hsu *et al*. (33) described 5 patients who underwent radical nephrectomy by the retroperitoneal approach, preserving the peritoneal membrane. That preservation helped in the immediate initiation of PD after the surgery. During postoperative care, the dialysate volume was kept low. None of the patients experienced any complications in terms of poor wound healing or peritoneal leakage. The authors preferred the retroperitoneal approach to the transperitoneal approach to preserve the peritoneal membrane.

Malavade and Bargman (34) assessed patients who underwent nephrectomy and then subsequently started on dialysis within 1 year. They also observed a patient who underwent nephrectomy while receiving PD. No wound dehiscence or any other surgical complication was observed. Postoperatively, that patient had a higher risk for incisional hernia and retroperitoneal PD fluid leak.

*PD and other abdominal surgeries*

BARIATRIC SURGERY

Not many case reports have been published about bariatric surgery in patients on PD. Imam *et al.* (35) described the case of a patient receiving PD who underwent successful bariatric surgery in the form of sleeve gastrectomy. The patient did very well in terms of both bariatric surgery and PD.

TABLE VI Peritoneal dialysis management in patients having hernia repair or leaks (to be used for at least 4 – 8 weeks)

| | |
|---|---|
| 1. | Low-volume peritoneal dialysis (approximately 1 L) |
| 2. | Supine peritoneal dialysis |
| 3. | Automated peritoneal dialysis |

TABLE VII Surgical approaches for mesh repair in patients on peritoneal dialysis

| | |
|---|---|
| 1. | Open compared with laparoscopic mesh repair |
| 2. | Extraperitoneal compared with intraperitoneal mesh placement |

TABLE VIII Complications of nephrectomy in patients on peritoneal dialysis

| | |
|---|---|
| 1. | Incisional hernia |
| 2. | Retroperitoneal dialysate leak |
| 3. | Loss of residual renal function |
| 4. | Need for more intense dialysis |

LAPAROSCOPIC CHOLECYSTECTOMY

Ekici *et al.* (36) assessed laparoscopic cholecystectomy in patients receiving PD. They compared laparoscopic cholecystectomy in 11 PD patients with the same procedure in 33 patients not on PD. None of the PD patients experienced peritonitis, leaks, or hernias.

OSTOMIES

The main concerns about PD in patients with ostomies are leaks, gross contamination, recurrent peritonitis, and exit-site infection. In 1992, Korzets *et al.* (37) described good outcomes in PD patients with stomas. In 1998, Twardowski *et al.* (38) published 6-year data about the successful use of pre-sternal PD catheters in patients with any kind of abdominal complication including ostomies, demonstrating that PD can still be used in such patients just by changing the exit site of the PD catheter—that is, moving it away from the ostomy site. Similarly, Chadha *et al.* (39) successfully used pre-sternal PD catheters in children with a colostomy.

**Summary**

There is reluctance among surgeons and physicians about performing or continuing PD in patients with

various abdominal complications, including abdominal surgeries. Here, we have tried to clarify some of the misconceptions. Our review of literature indicates that, in most instances, PD can be performed safely in such patients. An assessment of the possible complications, including abdominal surgeries, in this patient population, with appropriate tailoring of the PD prescription, can allow these patients to remain on PD without compromising their quality of life or increasing their health care expense.

**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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