Laparoscopic Intervention for Peritoneal Dialysis Catheter Malfunctions in the National Kidney and Transplant Institute: A Case Series

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Abstract

Introduction: Peritoneal dialysis (PD) is a renal replacement modality for patients with end-stage renal disease (ESRD). It is comparable to hemodialysis, allows autonomy since it is done at home, thus improves quality of life. Placement of an abdominal catheter for dialysis is commonly an open surgical technique. Complications are due to mechanical causes and may require multiple open surgical corrections. Peritoneal dialysis initiation is commonly performed in our institution. Alternative technique such as laparoscopy can treat recurrent catheter malfunctions.

Methodology: Adult patients with a previous open PD catheter insertion (PDCI) and subsequent catheter replacement that malfunctioned were selected for laparoscopy between January to December 2020. Laparoscopic procedure included declogging, catheter repositioning/fixation to anterior pelvic abdominal wall, omentectomy. Low volume dialysis with heparinization concluded this.

Results: Seventy percent had successful catheter function postoperatively. Omental wrapping and catheter tip migration were the most common malfunction causes. Two patients were shifted to hemodialysis due to abdominal pain and hemoperitoneum. One patient expired from COVID. There were no trocar site herniations or surgical site infections.

Conclusion: Peritoneal dialysis is an option for ESRD patients. PD catheters can malfunction, hence surgical correction may be needed. Historically, open surgical technique is preferred. With laparoscopy, direct visualization of intraperitoneal cavity allows diagnosis and targeted treatment for malfunction. Laparoscopic correction of PD catheter (LPDC) is a fast, safe, effective alternative to open technique in managing previous open PDCI failures.

Keywords: peritoneal dialysis (PD); end-stage renal disease (ESRD); peritoneal dialysis catheter insertion (PDCI); laparoscopic correction of PD catheter (LPDC)

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Introduction

Peritoneal dialysis (PD) is a type of renal replacement therapy (RRT) for patients with end-stage renal disease (ESRD). It is comparable to hemodialysis and achieves similar outcomes. Aside from its effectiveness, it allows patients with ESRD some autonomy because it can be done safely at home. For patients with ESRD who are chronically dependent on hemodialysis units, peritoneal dialysis is another option which can improve quality of life.[1,2]

Peritoneal dialysis involves the removal of excess water, excess electrolytes, and metabolic waste products by creating an osmotic gradient between the blood and the PD solution. Along with the osmosis of water, removal of electrolytes and toxins occur via ultrafiltration-associated convection (also known as solvent drag or bulk transport).[1] The PD solution or dialysate is infused into the abdominal cavity via a PD catheter.

Placement of a PD catheter in the abdominal cavity can be done through several techniques, which are either surgical or non-surgical. Surgical insertion, whether open or laparoscopic, is more commonly performed due to its safety and ability to achieve proper placement. Percutaneous insertion is less invasive with a comparable success rate to surgical techniques, but has a higher risk of bowel perforation. There is also a higher chance of improper placement. It is usually reserved for patients who cannot tolerate general anesthesia or hemodialysis, especially if rapid initiation of dialysis is needed.[3]

Unfortunately, malfunctioning PD catheters may occur, of which, infection is the most frequent cause.[4] Outflow failure is defined as the incomplete recovery of instilled dialysate due to mechanical causes.[5] It occurs in 4% - 34.5% of PD patients.[6] Depending on the cause, it may be treated conservatively or may require surgical intervention, such as catheter replacement.[5] Catheter malfunction may be due to a displaced catheter tip or migration, catheter lumen obstruction by fibrin and blood clots, omental wrapping of the catheter, and adhesions in the abdomen and pelvis.[7] Among the causes of outflow failure, catheter obstruction due to omental wrapping and catheter tip migration usually warrant surgical intervention.[6,7]

In the National Kidney and Transplant Institute (NKTI), a tertiary medical specialty center that caters to kidney patients, dialysis initiation is one of the most frequent procedures performed. Peritoneal dialysis is offered to ESRD patients especially if they are suitable candidates. Peritoneal dialysis catheter insertion is frequently performed in the institution via open surgical technique. After initial catheter insertion, outflow failure may occur. If possible, it is managed conservatively. But if indicated and conservative management fails, surgical correction via replacement of the peritoneal dialysis catheter is done. As was previously mentioned, omental wrapping and a migrated catheter tip usually warrant surgical intervention. Unfortunately, there are a number of patients with recurrent malfunction such as these and may end up undergoing several catheter replacement procedures. An institutional study done in NKTI showed PD catheter tip migration and tip migration with omental wrapping as the most common causes of malfunction in 2017. These malfunctions underwent subsequent open PD malfunction surgery with overall catheter survival at 79.26%, 61.48%, 48.89% for 1, 3, and 6 months respectively.[8]

More recently, open PD catheter insertions in our institution had a 6.67% and 8.6% failure rate in 2019 and 2020, respectively, which required open PD catheter replacement on the same admission.

Laparoscopic surgical correction may be offered to these patients with recurrent malfunction. Laparoscopic correction of PD catheter (LPDC) malfunction is an alternative surgical modality which allows replacement or repositioning of a catheter under direct visualization.[9,10,11] Laparoscopy also allows omentectomy or omentopexy to be performed in order to treat omental wrap.[12,13] For recurrent cases of outflow failure with repeated catheter replacement surgeries, laparoscopy is ideal. It is superior to open techniques in terms of shorter length of hospital stay, less invasiveness, lower postoperative pain, and faster recovery.[14] However, there is no standardized procedure recommended for the surgical correction of recurrent PD catheter malfunction. In our institution, where peritoneal dialysis is a common RRT modality for our patients, there is a need to utilize better techniques in correcting these recurrent malfunctions.

In our institution, where peritoneal dialysis is a common RRT modality for our patients, there is a need to utilize better techniques in correcting these recurrent malfunctions. Hence, we performed laparoscopic PD catheter repositioning, PD catheter fixation, and omentectomy on patients in our institution with recurrent PD catheter malfunctions that warrant surgical intervention. The goal of this technique was to address the common causes of outflow failure (omental wrap, catheter tip migration) and prevent further recurrence in order to avoid the need for possible future surgical correction, as well as to come up with a simple corrective procedure that can be done easily by general surgical residents in training using basic tools in laparoscopy. Based on retrospective studies, laparoscopic salvage of malfunctioning PD catheters have a success rate of 82-100% early on. However, the long term success (>30 days) becomes variable. Some studies show success rates as low as 62% after 1 month.[15]

Methodology

Adult ESRD patients for peritoneal dialysis initiation are referred to our Surgery department at National Kidney and Transplant Institute for peritoneal dialysis catheter insertion and post-insertion management. PD catheter malfunction is managed by both our department and the Nephrology department. Surgical correction is performed by our department if indicated. For our study, we selected all laparoscopic peritoneal dialysis corrections done from inception (which started January 2020) up to December 2020. These cases included recurrent PD catheter malfunction with a history of previous open surgical correction that required repeat surgical intervention. Specifically, patients who had undergone a previous open surgical PD catheter insertion followed by an open surgical PD catheter replacement procedure (thus a total of two open PD catheter procedures), with subsequent malfunction, were referred for laparoscopic correction of PD catheter malfunction. These patients were included in the study. Laparoscopic PD catheter repositioning to the pelvic area was performed for cases of migration. Fixation to the anterior abdominal wall using transfascial sutures was performed for all cases. Declogging of the catheter was done if there was note of catheter obstruction intraoperatively. Lysis of adhesions were done if needed. Omentectomy, partial or total, was also performed as needed to prevent further episodes of omental wrapping. This was done using an energy device or via manual ligation with ties via the umbilical port. Heparinization (1:50,000 solution) of the PD catheter was also performed for all cases.

Laparoscopic correction procedure: PD catheters used in our institution are pre-curved two-cuff Tenckhoff catheters. Before laparoscopic correction was attempted, conservative nonsurgical management was done first. This included catheter flushing, administration of bowel-cleansing or laxative products for clinical and/or radiographic evidence of constipation, heparin-infused peritoneal dialysis for possible blood clot obstruction. Procedure was performed in the operating room with the patient in supine position under general anesthesia. Laparoscopy was performed using 3-port technique, with the first 10mm port placed in the umbilicus for the camera, and the second and third ports placed at the upper and lower quadrants contralateral to the insertion of the catheter (Fig. 1). This setup enabled proper triangulation and versatility as we also made use of a 5mm camera. This setup also enabled us to operate both the upper and lower abdominal areas. After declogging the catheter, it was repositioned and anchored to the anterior abdominal wall using a suture passer or intracorporeal suturing, with the absorbable suture tied on the skin surface. Omentectomy, whether partial or total, was also performed, either with an energy device or via suture ligation at the umbilicus. Low volume PD with 500cc dialysate was also performed prior to conclusion of the procedure, so as to test catheter patency. Heparinization of the PD catheter was also performed. All incisions were then closed primarily using absorbable sutures.

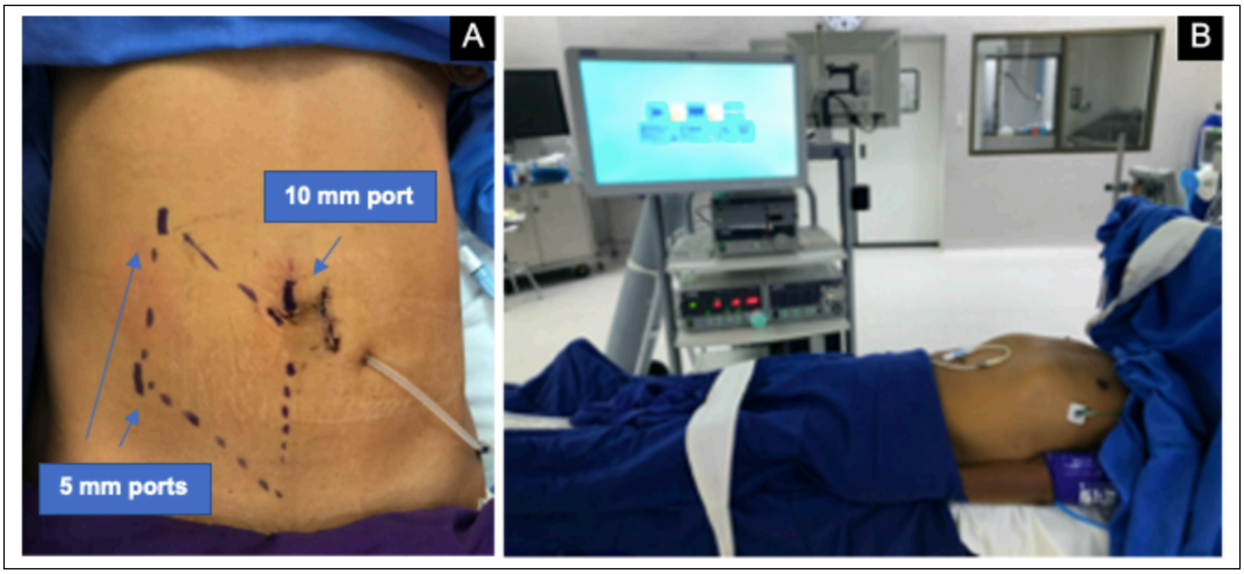

Fig. 1. Patient positioning and placement of trocars. (A) Laparoscopic 3-port placement technique: Ports in umbilicus, upper and lower quadrants contralateral to catheter insertion site. (B) Patient in supine position, arms at side, with monitor facing surgeon.

Data were collected through chart review from the Medical Records section, from our departmental electronic operative reports, and from records from the CAPD (Continuous Ambulatory Peritoneal Dialysis) clinic.

Successful catheter function was defined as adequate ultrafiltration without the need for subsequent surgical correction or transfer to hemodialysis.

Results

We selected 10 patients which fit our criteria for laparoscopic correction of PD catheter malfunction (Table 1).

In our institution, adequate ultrafiltration is defined by the presence of a negative ultrafiltration rate up to a positive ultrafiltration rate of 200 ml. This signifies that there is a higher amount of ultrafiltration fluid being drained from the peritoneum compared to the dialysate solution that was infused intraperitoneally. Poor drains or inadequate ultrafiltration is defined as the presence of a positive ultrafiltration rate more than 200 ml. This signifies that the amount of ultrafiltration fluid drained is less than the dialysate solution which was infused intraperitoneally.

Out of the 10 patients in our study, 7 patients (70%) were found to have omental wrapping of the PD catheter tip as discovered during laparoscopic correction, while 5 patients had PD catheter failure due to PD catheter tip migration (50%). Four patients (40%) had both omental wrap and PD catheter tip migration, making these two causes the most common causes of catheter malfunction in this study. This is consistent with other studies wherein migration and omental wrap are the most common findings during laparoscopic correction.[15] Other causes of catheter malfunction among these patients were fibrin (20%) and blood clot obstruction (10%), small intestinal wrap and adhesion (10%), and ovarian fimbrial wrap (10%).

After the laparoscopic correction, 2 patients were shifted to hemodialysis. One was due to hemoperitoneum from omental bleeders on the 2nd post-operative day. Patient subsequently underwent exploratory laparotomy, evacuation of hemoperitoneum and omental ligation.

The 2nd patient was shifted to hemodialysis due to persistent abdominal pain during peritoneal dialysis. One patient also expired from critical COVID before reaching the 1-month follow-up from laparoscopic correction.

Seventy percent of the patients (7/10) had occasional episodes of positive drains during peritoneal dialysis but overall, had good PD catheter function with adequate ultrafiltration.

Additionally, the mean operative time of the procedures was 98.6 mins (37-146 mins). Average post-operative hospital stay was 11.5 days (3-41 days). Hospital discharge of these patients depended mostly on the presence of normal electrolyte levels and good ultrafiltration rates. Post-operative pain control was achievable mostly with oral non-NSAID analgesics which were given continuously for a few days. Additional pain medication was also given as needed for moderate to severe pain, which was not controlled by the initial continuous medication prescribed. Among the patients, only 3 needed an additional dose of medication immediately post-operatively. One patient complained of severe abdominal pain post-operatively due to the presence of hemoperitoneum. One patient developed a trocar site leak in the right lower quadrant. PD was held for 3 days and trocar site was subsequently resutured. There was no recurrence of leak thereafter. There were no trocar site herniations noted. Also, there were no reported surgical site infections among these patients.

Discussion

For peritoneal dialysis to become successful as renal replacement therapy (RRT), it is important to establish a reliable access to the peritoneal cavity. Peritoneal access is achieved by inserting a catheter into the peritoneal cavity that traverses the abdominal wall. This catheter allows the exchange of dialysis solutions.[16] There are few absolute contraindications to PD catheter placement for RRT. These include documented loss of peritoneal function or ultrafiltration failure of the peritoneal membrane, impaired physical and mental ability to perform PD on a daily basis (considering that there is no trained companion for the patient), severe protein malnutrition and/or proteinuria >10 g/day, active intraabdominal/ abdominal wall/ skin infection. Active intraabdominal wall infection such as Crohn's disease, ulcerative colitis, and ischemic colitis can cause catheter infection via direct contact.[15] Infection is the most common cause of PD malfunction.[4,15] The second most common cause would be mechanical malfunction of the catheter.[15]

There are a number of PD catheter types with the most commonly used in clinical practice. There are straight versus pre-formed curved catheters, coiled versus straight tip catheters, and single versus two-cuff catheters. In our institution, we make use of the two-cuffed tenckhoff catheter with pre-formed intercuff arc bend and coiled tip is used (Fig. 2). There is allegedly no significant difference in functionality between the straight and coiled-tip catheters. The two-cuff catheter allows better immobilization within the abdominal wall. The deeper cuff is implanted in the muscle layer above the parietal peritoneum which allows fixation of the catheter. The superficial cuff is implanted in the subcutaneous tissues, around 2-4 cm from the exit site. This prevents continuous movement of the catheter along the tract and serves as a barrier to entry of debris and bacteria through the exit site (Fig. 3)[16] We follow this implantation technique in all of our cases.

The choice of PD catheter insertion procedure depends on a number of factors such as operator expertise and availability, ease of access to a procedure room, patient condition, available material and equipment, cost. Aside from appropriate choice of PD catheter insertion procedure, proper patient preparation and performance of procedure is important to ensure long-term peritoneal access survival.

In our institution, open PDCI is the preferred technique. This particular technique can be done in most patients under local anesthesia. It is relatively inexpensive, needing minimal resources, has a very low learning curve, and has acceptable complications. Thus it is ideal in a high-volume government hospital such as ours. The very low learning curve is especially

Fig. 2. Tenckhoff catheter with preformed intercuff arc bend, two cuffs, and coiled tip

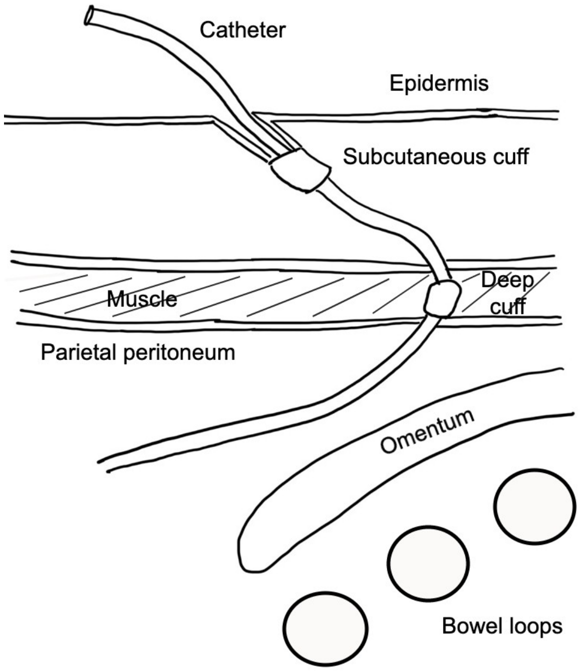

Fig. 3. Peritoneal dialysis catheter and relation to abdominal wall structures

advantageous since these cases are almost entirely performed by first and second year general surgery residents.

More recently, our institution has started venturing towards laparoscopic PD catheter procedures. Given the very high volume of patients in our institution, our selection criteria for LPDC included patients with two previous failures with the open PDCI technique. This selection criteria was very much arbitrary, and took into consideration available hospital resources.

The two most common causes of catheter malfunction were omental wrap and catheter tip migration. This is consistent with other studies wherein migration and omental wrap are the most common findings during laparoscopic correction.[8,16] Based on literature, LPDC had success rates of 82-100% for the 1st month. However, success rates >30 days became variable with failure rates as high as 60%.[15] Comparing this with our 1 month success rate of 70%, a larger study sample may be needed to yield more comparable results. However, the 3 month success rate was maintained at 70% which is higher than some success rates of previous studies. It is also slightly higher than the catheter survival of open PD catheter replacement in our institution at 61.48%.[8] There was also noted catheter survival for the patients with follow-up at 6 months (4 out of 7 patients).

Furthermore, out of the 3 LPDC failures in our study, one of them expired due to COVID-19 disease before the 1 month follow-up, making it impossible to determine the success of the LPDC procedure. One of the LPDC failures was also due to hemoperitoneum due to omental bleeders. Bleeding is one of the complications of open PD catheter replacement as well and should be managed surgically if needed.[15]

Based on literature, outcomes of laparoscopic correction of PD catheters had catheter patency rates of 97.2% at 1 month and 62% at 12 months. The advantage of laparoscopic exploration allows the surgeon to directly visualize the reason for catheter malfunction, and thus individualize the treatment for each patient. Studies showed that catheter latency becomes variable in the long-term and this may be dependent on a number of other factors that relate to loss of peritoneal function or ultrafiltration failure of the peritoneal membrane.[15]

Additionally, an important complication that should be monitored in post-laparoscopic correction of these patients is trocar or port site leakage. This is why only 5 mm ports are recommended by some studies while 10 mm ports should include closure of the fascia.[15] For the 10 patients in our series, none developed post-operative port leakage despite resuming peritoneal dialysis.

Other advantages of laparoscopy as a minimally invasive abdominal surgical procedure is the decreased post-operative pain compared to open procedures.[17] In our institution, intravenous pain medications are usually needed for pain control of open PD procedures. For our LPDC procedures, oral analgesics is usually sufficient. There is also faster recovery and earlier hospital discharge in laparoscopic procedures.[17] However, another factor for earlier hospital discharge among these patients is that they are already trained in performing PD. Patients after an open PD catheter insertion procedure usually have a longer hospital stay because they have to be trained in performing PD properly.

Given that this is a newly initiated technique in our institution, a descriptive report of the first few cases of LPDC confirms that the most common causes of PD catheter malfunction have been consistent. PD catheter tip migration and omental wrapping are the most common causes and may even occur simultaneously which makes LPDC ideal for addressing these two issues. However, as with the open technique, LPDC also has possible complications such as bleeding due to adhesiolysis or omentectomy. Trocar site leak is another complication unique to LPDC which makes appropriate trocar site closure critical intraoperatively.

Other risk factors that may affect PD catheter survival include older age and diabetic nephropathy. Age was shown to be a predictor of PD catheter survival as well as patient survival. Older patients have more comorbidities that result in lower patient survival leading to earlier withdrawal from PD. Diabetic nephropathy is one of the causes of chronic kidney disease that warrant dialysis. In patients with diabetic nephropathy, there was higher risk of peritoneal infection that lead to increased rate of PD catheter removal and patient mortality. On the other hand, some studies showed that female sex was found to be a protective factor from PD catheter failure.[18]

Based on the patient characteristics of the two LPDC failures (26/F with CGN and 66/M with DKD), however, these assumptions may not necessarily be the case. Of note is the 2nd failure, which due to postoperative bleeding, was probably a direct result of inadequate hemostasis.

Previous studies showed that despite the advantageous technique of LPDC in directly visualizing the peritoneal cavity and addressing the catheter malfunction problem, failure can recur especially after 1 month. However, this is just a brief look into the success rate of LPDC. Further randomized studies with much larger sample size should be done in the future, as more LPDC procedures will be done in our institution.

Conclusion

Peritoneal dialysis is a renal replacement therapy option for patients with end-stage renal disease that can improve quality of life due to the autonomy that it gives to these chronically disabled patients. However, the catheter used for peritoneal dialysis may malfunction, wherein surgical correction is sometimes necessary. The standard surgical treatment for correction of a malfunctioning catheter has been an open technique historically. With the use of laparoscopy, one can diagnose the exact cause of catheter malfunction, as well as tailor your treatment to the specific cause of malfunction. Laparoscopy allows targeted treatment to the surgical causes of catheter malfunction. It can extend the amount of time of patency of a catheter until other non-surgical causes of malfunction come into play. LPDC is a fast, safe and effective alternative to the open technique in the management of previous open PDCI failures.

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Disclosure

Nicolette Deveras and Mark Melendres declare that we have no conflict of interest.

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Appendix

Patient code	Age	Sex	Etiology of CKD	PD Catheter Insertion (PDCI) Date	Subsequent PD Catheter Replacement Interval (in weeks)	Malfunction Cause of PDCI	Laparoscopic Correction (LPDC) Interval from PDCI (in weeks)	Malfunction Cause based on Intraoperative findings of LC	Type of Catheter Obstruction	Catheter Tip Position
1	26	F	CGN	07/08/2019	8 wks	TM	29 wks	TM, OW	OW	RH
2	54	F	CGN	11/02/2019	17.3 wks	TM, OW	18.7 wks	Left ovarian fimbrial wrap	Left ovarian fimbrial wrap	PC
3	54	M	DKD	07/09/2019	4 wks	PPD	26.6 wks	OW	OW	PC
4	42	F	CGN	12/28/2019	2.4 wks	PPD	2.9 wks	FO, OW	FO, OW	PC
5	27	F	CGN	04/25/2020	1.1 wks	TM, OW	11 wks	FO, TM, OW	FO, OW	RUQ
6	30	F	CGN	12/11/2019	2.6 wks	OW	3.9 wks	OW	OW	PC
7	66	M	HPNSS, DKD	06/07/2020	2.3 wks	TM	5.4 wks	TM, OW	OW	RLQ
8	65	F	HPNSS	01/23/2020	4.4 wks	TM	5.7 wks	OW	OW	PC
9	57	M	NSAID nephropathy	10/19/2019	4.6 wks	TM, PL	44.4 wks	BW, TM, BO	BW, BO	LH
10	25	F	CGN	09/10/2020	1.4 wks	TM, OW	4 wks	TM, OW	OW	Left sacroiliac joint

Table 1. Patient Demographics and Characteristics Relevant to Peritoneal Dialysis and Catheter Malfunction

Legend:
CGN – Chronic Glomerulonephritis
DKD – Diabetic Kidney Disease
HPNSS – Hypertensive Nephrosclerosis
NSAID – Nonsteroidal anti-inflammatory drug
TM – Tip migration
OW – Omental wrap
FO – Fibrin clot obstruction
BO – Blood clot obstruction
PPD – Persistently poor drains
RH – Right hemiabdomen
LH – Left hemiabdomen
RUQ – Right upper quadrant
RLQ – Right lower quadrant
PC – Pelvic cavity
PL – PD catheter leak
BW – Small intestinal or bowel wrapping/obstruction

Patient code	Time between PDCI and PD catheter replacement	Time between PD catheter replacement to LPDC	Time from PDCI to LPDC	Successful catheter function						Failure on Follow-up	Cause of PD Failure	Procedure-related Complications if any	Reason for Hospital Admission after Procedure
				Immediately after procedure	At PD start	1 week after PD start	1 month after PD start	3 mos after PD start	6 mos after PD start				
1	8 wks	18.7 wks	29 wks	GD, UF: -320	GD, UF: +174	GD, UF:-100	HD	-	-	-	Persistent abdominal pain during PD	-	-
2	17.3 wks	1.4 wks	18.7 wks	GD, UF: 0	PDr, UF: +550, GIGO	GD, UF: -350	GD, UF: -500	GD	NF	No	-	-	-
3	4 wks	20.7 wks	26.6 wks	GD, UF: -300	GD, UF: -800	PDr, UF: +600, GIGO	GD, UF: -400	GD	GD	No	-	-	-
4	2.4 wks	3 days	2.9 wks	PDr, UF: +1200, GIGO	GD, UF: -127	GD, UF: -900	GD, UF: -500	GD	GD	No	-	-	POD 120: PDr, UF: +950; discharged with GD, UF: -200
5	1.1 wks	9.1 wks	11 wks	PDr, UF: +546, GIGO	GD, UF: +200, GIGO, PL (PD on hold for 3 days)	GD, UF: -1153, NL	GD, UF: -500, NL	GD, NL	NF	No	-	-	-
6	2.6 wks	1.3 wks	3.9 wks	GD, UF: -437	PDr, UF: +1550	GD, UF: 0	GD, UF: -900	GD	GD	No	-	-	-
7	2.3 wks	3.1 wks	5.4 wks	GD, UF: -393	Hemo-peritoneum on POD 2, HD	-	-	-	-	-	Omental bleed	Hemo-peritoneum due to omental bleeding. Underwent exploratory laparotomy, evacuation of hemo-peritoneum and omental ligation	-
8	4.4 wks	8 days	5.7 wks	PDr, UF: +300, GIGO	PDr, UF: +592, GIGO	GD, UF: -1250	GD, UF: -300	GD	GD	No	-	-	-
9	4.6 wks	36.7 wks	44.4 wks	PDr, UF: +300, GIGO	PDr, UF: +223, GIGO	GD, UF: -150	Expired due to Critical COVID	-	-	-	-	-	-
10	1.4 wks	2.6 wks	4 wks	GD, UF: -350	PDr, UF: +1000, GIGO	PDr, UF: +400, GIGO	GD, UF: -200	GD	NF	No	-	-	POD 90: PD peritonitis, treated with IPA; GD, UF: -500

Table 2. PD Outcomes and Complications of Laparoscopic Correction Procedure

Legend:
GD – Good drains/adequate ultrafiltration
UF – Ultrafiltration
PDr – Poor drains/inadequate ultrafiltration
GIGO – Good inflow and outflow during PD catheter flushing
PL – Leak from PD catheter exit site
NL – No leak from PD catheter exit site
HD – Shifted to HD
POD – Post-operative day
NF – No follow-up
IPA – Intraperitoneal antibiotics

Patient code	Operative Time (mins)	PO Hospital Stay (in days)	Use of PRN Pain Reliever	PD Catheter Exit Site Leak	SSI	Incisional/ Trocar Site Hernia
1	115 mins	17	No	No	No	No
2	86 mins	5	1 dose immediately PO	No	No	No
3	91 mins	3	No	No	No	No
4	120 mins	4	No	No	No	No
5	82 mins	17	No	Yes, POD 2: RLQ trocar site, PD on hold; POD 4: Skin resuturing done, no leak recurrence	No	No
6	73 mins	3	No	No	No	No
7	130 mins	41	Yes (severe pain due to hemo-peritoneum)	No	No	No
8	146 mins	4	No	No	No	No
9	37 mins	17	1 dose immediately PO	No	No	No
10	106 mins	4	1 dose immediately PO	No	No	No

Table 3. Outcomes Relating to Laparoscopic Correction Surgery

Legend:
PRN – Additional pain medication as needed for moderate to severe pain
SSI – Surgical Site Infection
PO – Post-operative
POD – Post-operative day
RLQ – Right lower quadrant