Interventional Nephrology Primer: Part 2
Peritoneal Dialysis Catheter
2020

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Peritoneal Dialysis (PD) Catheter

Most people with kidney failure can be treated by peritoneal dialysis with few exceptions:
1. People who have had major abdominal operations. Scarring of the peritoneal membrane might cause it to be ineffective for dialysis.
2. People who are unable to care for themselves, or patients who need assistance.

Good things about PD (The Good Catheter)
- PD catheters have lower infection rate than permcath.
- Better quality of life and autonomy.
- PD catheter can be used acutely within 12 hours of insertion if needed (urgent start PD).
- Easy to transition to other dialysis modalities.
- Preserves the vascular real estate.
- Can be performed at home setting, avoiding exposure to crowded setting and infections.

Care for advanced CKD and ESRD patients is an integrated dynamic process with several transition points between peritoneal and hemodialysis.

### Transfer from PD to HD
1. Recurrent infection
2. Catheter malfunction
3. Ultra-filtration failure
4. Adequacy (solute) failure
5. Psychological burnout
6. Failure in daily activities
7. Uncontrolled diabetes
8. Significant weight gain

### Transfer from HD to PD
1. Recurrent CHF
2. Hemodialysis access failure
3. Hypercoagulability
4. Malnutrition
5. Nursing home care
6. Social factors (work, travel)
7. Intra-dialysis hypotension

**Integrated care for advanced CKD patient**
Types of PD catheters:

Anatomy of the Peritoneum

Principle of PD

Methods of PD catheter insertion
Open Surgical.
Laparoscopic.
Peritoneoscopic.
Fluoroscopic with ultrasound guidance.
Pre-op preparation protocol:

- NPO after MN the night prior to procedure.
- Check CBC, BMP, PT/INR.
- Hold blood thinners (5-7 days; see anticoagulation protocol).
- Assess for previous abdominal surgeries.
- BMI to determine the best insertion method.
- The procedure is signed off by a nephrologist.
- Bowel preparation the day before the procedure: 2 L of polyethylene glycol solution, enema, or stimulant suppository.
- Shower on the day of the procedure with chlorhexidine soap wash.
- Removal of body hair preferably with electric clippers.
- Empty the bladder before procedure (if needed, insert Foley catheter).
- Pre-operative antibiotic prophylaxis: (cefazolin, vancomycin, or clindamycin).

Key technical issues in PD implantation

1. Location of the catheter tip within the pelvis (shown): due to hydraulic function of the catheter and to prevent the omental entrapment.

2. Location of the exit site:

- Should be away from beltlines, skin creases, and folds.
- Should be **clearly visible** to the patient to perform daily exit site care.
- The direction of the exit is downward or lateral.
3. PD catheter cuffs:

- Two-cuff catheters with coiled intra-peritoneal segment are commonly used.
- The superficial cuff should be 1 inch away to exit site.
- The deep cuff is buried within the rectus muscle of abdominal wall.
- Two cuff catheters may lower the risk of *Staph aureus* peritonitis.
PD Catheter Fluoroscopic Insertion Procedure

- Prepping the patient
- Entering the peritoneal space
- Wire in the peritoneal space
- Sequential dilatation over the wire
- PD catheter in place
- Location of PD catheter cuffs
- 2 Layers suturing
- Dressing
Complications of PD

I. Mechanical Complications of Peritoneal Dialysis Catheter

<table>
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<tr>
<th>Catheter Flow Dysfunction</th>
<th>Peritoneal leakage issues</th>
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Flow dysfunction
1. Extrinsic compression of catheter tip.
2. Internal luminal obstruction.
3. Poor positioning and migration.
4. Tissue attachment and entrapment.

Peritoneal leakage issues
- Pericatheter leaks.
- Abdominal wall hernias.
- Pleuroperitoneal connection (fistula).

1. **Extrinsic compression of catheter tip**
   - Key causes: constipation and bladder distention.
   - Mechanism: obstruction of the catheter side holes by distended bladder or colon.
   - Check KUB and post-void residual urine volume.
   - Treat the cause.

![Constipation](images/constipation.png)

![Relief of constipation](images/relief_of_constipation.png)

![Neurogenic bladder](images/neurogenic_bladder.png)

PD catheter is between bladder and rectum
2. **Luminal obstruction**
   Key issues: tube kink or fibrin/blood clot.
   Mechanism: two-way luminal obstruction.
   Treatment: irrigate using syringe of saline; instill tPA to dissolve the fibrin clot; or use the wires under fluoroscopic guidance. Sometimes, PD catheter requires exchange.

3. **Poor positioning and migration**
   Key problem: unusual position of the PD tip causing poor flow.
   Mechanism: catheter resiliency memory forces and other factors.
   Treatment: fluoroscopic repositioning or exchange.

4. **Tissue attachment and entrapment**
   Key issue: one-way or two-ways poor flow.
   Mechanism: entrapment due to omentum or adhesions.
   Treatment: laparoscopic intervention.
Peritoneal leakage issues

i. Pericatheter leaks
Mostly seen in urgent start of PD catheter. Supine small volume dialysate exchanges. Decrease physical activities. May require switching to hemodialysis.

ii. Abdominal wall hernia
Due to increased intra-abdominal pressure. Obesity and steroid use are risk factors. May require surgical repair.

iii. Hydrothorax (Pleuroperitoneal connection).
Pathogenesis: The movement of the dialysate from the peritoneal to pleural space through defects present in the diaphragm. Treatment: low volume dialysate, pleurodesis, or pleuroscopic repair.

II. Infectious Complications of PD

Infectious complications are the most common cause for the loss of the peritoneal dialysis catheter and switching to hemodialysis.

1. Exit-site infections

Healthy exit site
Natural skin color. No scab, crust, or granulation tissue. No visible drainage. Epithelium covers whole visible sinus. Epithelium is snug around the catheter.

Acute exit site infection
Usually related to poor exit site care

Culture and Gram stain of drainage
Start empiric antibiotic therapy
Ultrasound of catheter track
Exit site care
2. Tunnel infections

Treatment:
1. Culture and Gram stain of drainage
2. Initiate empiric antibiotics (that includes *Staphylococcus aureus* coverage).
3. Refer to a surgeon to determine next step/intervention.

3. Superficial cuff extrusion

Treatment:
1. Exit site care.
2. Removal of the extruding cuff (shaving) allows the exit site to heal.

4. Peritonitis

**Peritonitis:** 2 of 3 criteria
1. Signs and symptoms (Abdominal pain, fever).
2. Cloudy fluids (>100 WBC/ml; 50% Neutrophils).
3. Identification of an organism.

**Source of Peritonitis:**
a. Contamination 41%
b. Catheter related 23%
c. Enteric injury 11%
d. UTI 4%
e. Others 22%
Flow Chart for Peritonitis Assessment

Peritonitis: gross and microscopic appearance

Indications for PD Catheter Removal due to Infections
a. Refractory peritonitis.
b. Relapsing peritonitis.
c. Fungal peritonitis.
d. Refractory exit site and tunnel infections.
e. Consider removing the PD catheter if not responding to therapy:
   Multiple enteric organisms
   Mycobacterial peritonitis
Encapsulating peritoneal sclerosis (EPS):

EBS is characterized by a fibrocollagenous membrane encasing the small intestine, resulting in recurrent small bowel obstructions. EPS is most commonly associated with long-term peritoneal dialysis. The mortality rate for EPS is high, primarily due to complications related to bowel obstruction.

Color of Peritoneal Dialysis Effluent as a Diagnostic Tool

- **Bloody effluent**
  - Menstruation
  - Ovulation
  - Ovarian cyst rupture
  - Anticoagulation

- **Cloudy Effluent**
  - Infections
  - Reactive
  - Idiopathic
  - Neoplastic

- **Yellow green effluent**
  - Cholecystitis

- **Milky effluent**
  - Lymphoma
  - Trauma
  - Medications

- **Black brown effluent**
  - Rhabdomyolysis

- **Normal effluent**

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References:
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