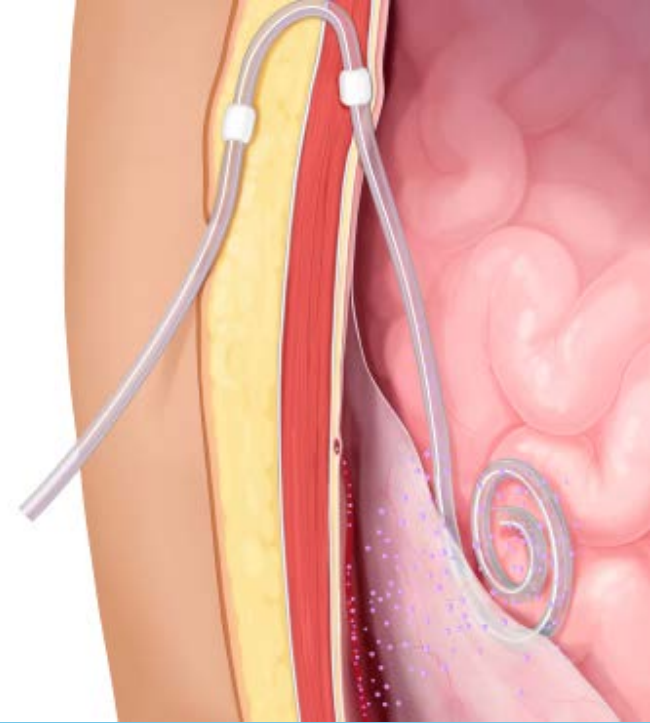


**PERITONEAL
DIALYSIS**
**NON-INFECTIOUS
COMPLICATIONS**
OF PERITONEAL
DIALYSIS
CATHETER-RELATED
PROCEDURES

PERITONEAL DIALYSIS
TRAINING PROGRAM



Medtronic
Further, Together

NONINFECTIOUS COMPLICATIONS OF PD^{1,2}

Non-Infections PD Complications

Catheter-Related	Intra-Abdominal Pressure-Related	Metabolic	Other
<ul style="list-style-type: none"> ▪ Perioperative perforation <ul style="list-style-type: none"> ▪ i.e. bladder or bowel ▪ Catheter dysfunction ▪ Leakage <ul style="list-style-type: none"> ▪ Abdominal wall or pericatheter ▪ Cuff extrusion ▪ Pain on infusion or drainage 	<ul style="list-style-type: none"> ▪ Hernia ▪ Pleural leak (hydrothorax) ▪ Abdominal leaks ▪ Genital edema ▪ Back pain ▪ Shoulder pain (pneumo-peritoneum) ▪ GERD/Delayed gastric emptying 	<ul style="list-style-type: none"> ▪ Hyperglycemia ▪ Hypertriglyceridemia ▪ Hyperinsulinemia ▪ Hyperleptinemia 	<ul style="list-style-type: none"> ▪ Hemoperitoneum ▪ Encapsulating peritoneal sclerosis ▪ Electrolyte abnormalities

¹McCormick and Bargman. 2007.

²Bender. 2012.

PERIOPERATIVE BOWEL PERFORATION AND VISCERAL INJURY

Description	Well-recognized and most serious complication of insertion procedure. Occurs when entering into the abdominal cavity and advancing the catheter into lower abdomen.
Incidence	Rates range from 0-2%, depending on insertion technique ^{3,5}
Cause	Perioperative complication
Prevention	Technique dependent, use of imaging thought to improve safety (i.e., fluoroscopic guidance) ⁴
Symptoms	Pain, nausea, bleeding, rigid abdomen ⁵
Management	Terminate procedure to avoid infection and peritonitis. NPO and treat with triple antibiotics. Repeat attempt at insertion after 2-week course of antibiotics. ⁴

¹McCormick and Bargman. 2007.

²Bender. 2012.

³Haggerty, et al. 2014.

⁵Peppelencosch, et al. 2008.

CATHETER DYSFUNCTION

Description	Early poor flow is frustrating for patients and negatively impacts their experience with PD. May be due to blockage, catheter migration or entrapment, or bladder compression due to urine retention. Constipation is a common cause. ¹
Incidence	Up to 38% ³
Causes	<ul style="list-style-type: none">▪ Constipation may cause catheter migration and external compression of the lumen ¹▪ Clot, omental wrap, adhesions, catheter tip migration ⁵
Prevention	Patient education is important to avoid the issue and provide adequate bowel care ²
Symptoms	Inadequate dialysate inflow or outflow
Management	Evaluate cause of dysfunction. Management of constipation with high doses of laxative, flushing or infusion of thrombolytics for clot, guidewire manipulation under imaging, laparoscopic salvage ¹

³Haggerty, et al. 2014.

⁴Abdel-Aal, et al. 2014.

⁵Peppelencosch, et al. 2008.

EVALUATION OF CATHETER DYSFUNCTION^{1,3,6-8}

- Check external causes
 - Mechanical obstruction
 - Clamps, tubing kinks, external tubing/connector blockage, connectors
 - Patient position
- Rule out
 - Constipation, peritonitis, catheter malposition, catheter obstruction, ultrafiltration issues
- Diagnostics
 - Abdominal x-ray, fluoroscopy with contrast, MRI, CT peritoneography, peritoneal scintigraphy
 - Examination of PD drainage
- Consider
 - Catheter flushing or irrigation
 - Non-invasive maneuvers & guidewire guided repositioning for suspected malposition
 - Thrombolytic instillation
- Advanced interventions
 - May involved laparoscopic management of omental wrapping, adhesiolysis, hernia repair, repositioning, or replacement of catheter

¹McCormick and Bargman. 2007.

³Haggerty, et al. 2014.

⁶Gokal, et al. 1998.

⁷Kellman and Watson. 2006.

⁸Bammens, et al. 2014.

TYPES AND LOCATIONS OF LEAKAGE⁹

- Pericatheter
- Prior surgical incision site
- Patent processus vaginalis
- Non-specific areas of peritoneum

⁹Leblanc, et al. 2001.

ABDOMINAL WALL OR PERICATHETER LEAK

Description	Leakage of dialysate either at the exit-site or loss into the peritoneal cavity due to poor implantation, anatomical issues, or use of the catheter prior to healing. Highest risk patients include those with healing issues (diabetic, elderly, malnourished, corticosteroid use) and increased intra-abdominal pressure. ⁹
Incidence	Approximately 5%, insertion technique dependent ⁹
Causes	<u>Early leaks</u> : (<30 days): Typically related to placement issues; more commonly pericatheter, exit site or incision site leaks <u>Late leaks</u> : Mechanical or surgical tear; hernias; present as internal leakage ⁹
Prevention	Allow catheter to heal for 2 weeks before use. ⁹ Low volume PD in supine position until tunnel is well healed. ²
Symptoms	Pericatheter leak: Wetness or swelling at exit site Abdominal swelling or boggiess, Diminished effluent return, Weight gain and abdominal wall edema without peripheral edema; genital edema, dyspnea for pleural leak ⁹
Management	Evaluation of cause. Early recognition, dressing changes at exit site, and antibiotics to prevent infection. Low pressure PD or temporary HD during healing ²

²Bender, et al. 2012.

⁹Leblanc, et al. 2001.

ABDOMINAL WALL OR PERICATHETER LEAK⁹

- Diagnosis
 - Physical exam
 - Unchanged PET results yet suggested volume overload
 - Contrast CT scan (100 mL per 2 liter bag)
 - MRI (no contrast – use plain dialysate)
 - Pericatheter leak: Ultrasound around exit site
 - Verify fluid content using glucose test strips

⁹Leblanc, et al. 2001.

CT SCAN WITH IP CONTRAST

DEMONSTRATING LEAK THROUGH CATHETER INSERTION SITE

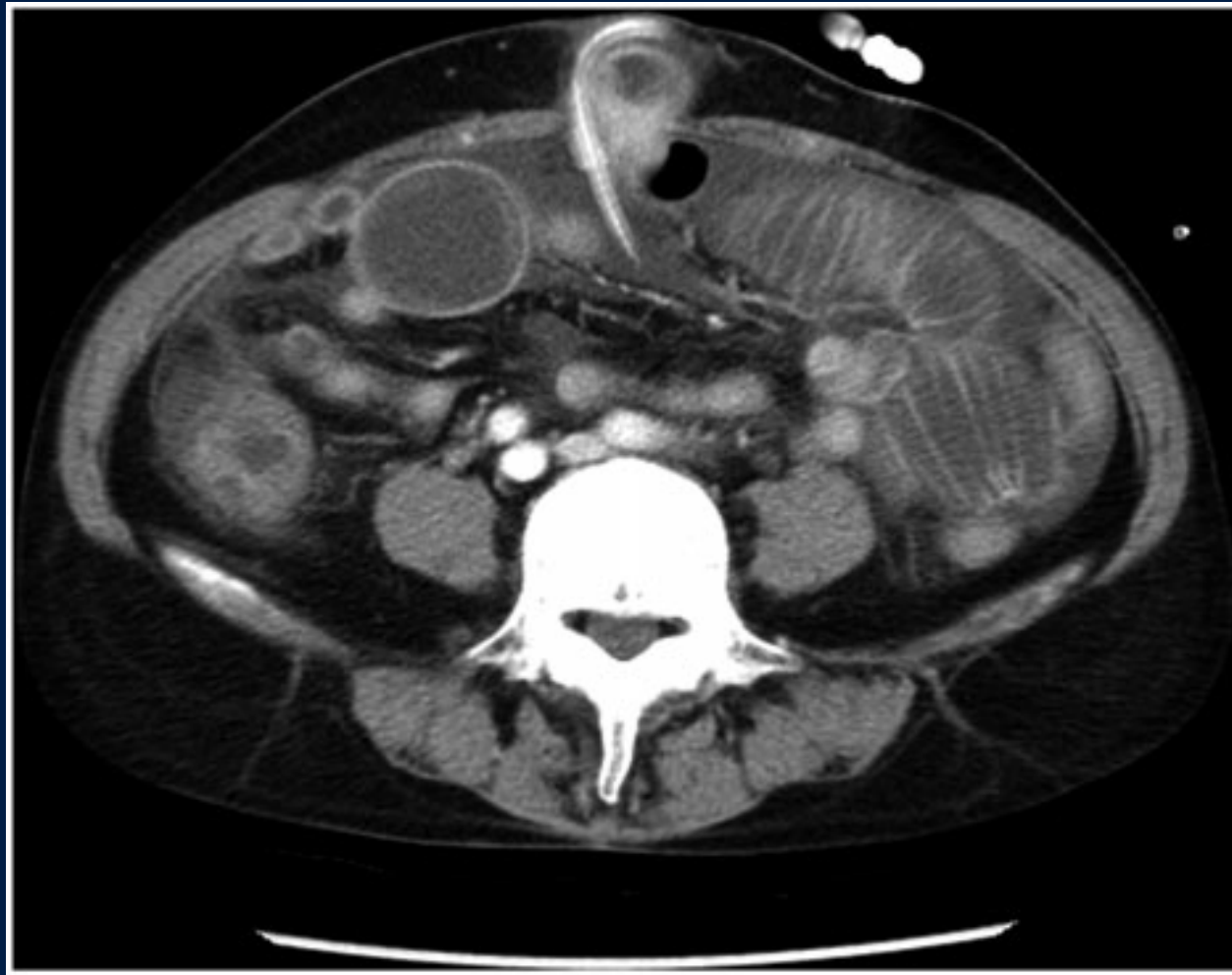


Photo courtesy of Cheol Whee Park, MD

TREATMENT OF PERITONEAL FLUID LEAKS⁹

- Temporarily stop PD with short-term transfer to hemodialysis
 - Defect may spontaneously repair after 1-2 weeks of rest, or may take up to a month
- Consider low volume/pressure supine dialysis (NIPD)
- Surgical repair for some leaks
 - Patent processus vaginalis
 - Pericatheter leak
 - Fibrin glue infiltration³
 - Genital swelling

³Haggerty, et al. 2014.

⁹Leblanc, et al. 2001.

HERNIAS

Description	While known hernias should be fixed prior to initiation of PD, installation of dialysate into the peritoneal cavity increases pressure in the abdomen and rising pressure may cause hernia to occur in weak areas.
Incidence	Wide range of reported incidence depending upon screening and repair before catheter placement: as low as <5% ^{2,10} to 30% in adults and 40% children for abdominal wall hernias ³
Cause	Weak area of abdomen wall and high pressure of dialysate ^{2,10}
Prevention	Pre-insertion physical exam and knowledge of any pre-existing abdominal weakness. Repair as needed prior to PD.
Symptoms	Painless swelling or painful lump in abdomen; severe cases may present as bowel obstruction or strangulation ¹⁰
Management	Diagnosed via CT peritoneography. Small hernias can be watched carefully. ² For larger hernias, treatment requires surgical repair and post-op recovery on low volume intermittent dialysis or hemodialysis. ¹⁰

²Bender, et al. 2012.

³Haggerty, et al. 2014.

¹⁰Saha and Singh. 2007.

TYPES OF HERNIAS¹⁰

- Incisional
- Inguinal
- Umbilical
- Epigastric
- Ventral
- Obturator
- Foramen of Morgagni

¹⁰Saha and Singh. 2007.

HERNIAS

RISK FACTORS^{9,10}

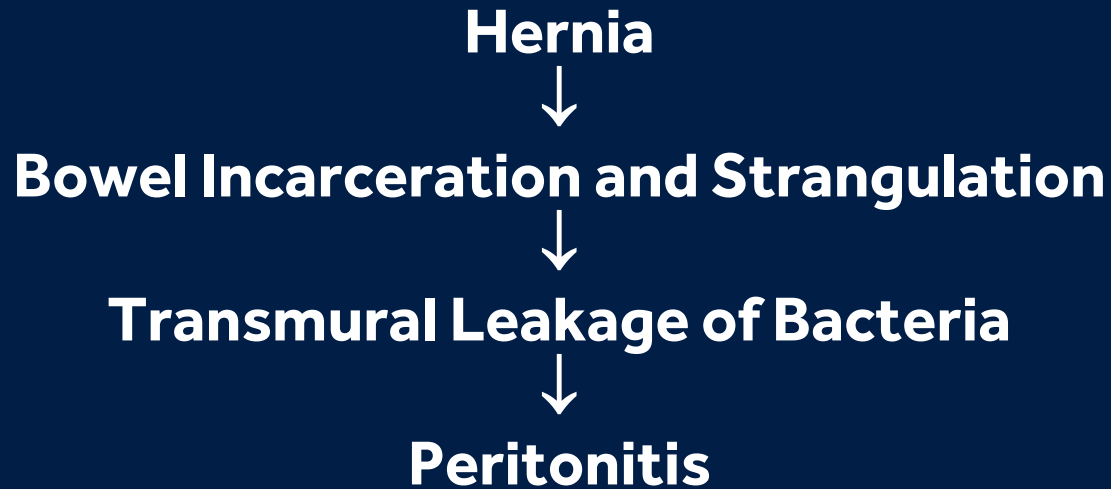
- Multiple pregnancies
- Elderly males
- Previous hernia repair
- Previous abdominal surgery
- Abdominal obesity
- Midline incision for PD catheter placement

⁹Leblanc, et al. 2001.

¹⁰Saha and Singh. 2007.

HERNIAS

COMPLICATIONS OF HERNIAS¹⁰



¹⁰Saha and Singh. 2007.

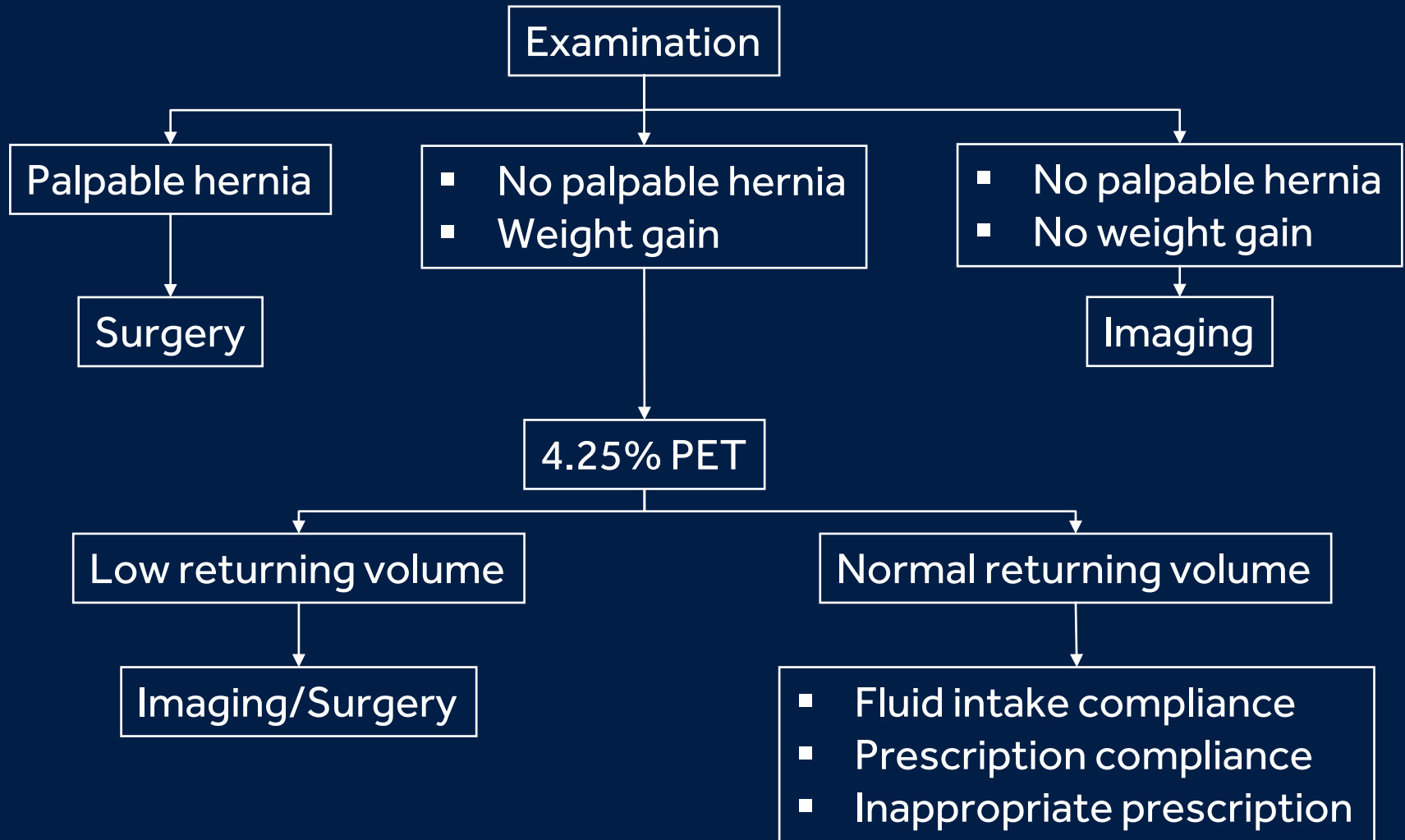
A CLINICAL APPROACH TO A PD PATIENT WITH HERNIA²

- Determine likelihood for incarceration/strangulation (size/location) - warn patient of the risk and symptoms
- Always rule out incarcerated bowel within a hernia if patient presents with peritonitis
 - Repair surgically if patient is at low risk
 - Temporary transfer to HD post-op best option
 - Hyperdialyze for days pre-op, then low volume APD post-op
 - Use RRF, operate sooner rather than later
- Some large hernias do not need repair
- Location rather than size is the incarceration risk
- Consider low volume supine dialysis

²Bender. 2012.

EXAMPLE

EVALUATION OF SCROTAL EDEMA



PAIN DURING INFUSION OR DRAINAGE

Description	Inflow or outflow pain that occurs during exchange of dialysate, especially common during the early use of the catheter. ²
Causes	<ul style="list-style-type: none">▪ pH of dialysate: 5.0-5.5 infusion into the abdomen may cause discomfort.▪ Solution too warm or too cold may increase discomfort.▪ May be due to placement of the catheter too deep in the abdomen or position of the catheter tip against pelvic wall, bladder or rectum.⁴
Prevention	Placement is critical as catheters that are placed too deep in the pelvis might produce infusion or drain pain. ⁴
Symptoms	Discomfort during inflow or outflow of dialysate
Management	<ul style="list-style-type: none">▪ Rule out peritonitis.▪ Use of Tidal PD (75% to 90% tidal volume, cycler best) or allow time and encourage patient to keep trying as pain may resolve on its own.²▪ Consider addition of few mL of NaHCO₃ to dialysate if persistent (can increase peritonitis rate) and ensure dialysate is body temperature.▪ Extreme cases may require replacement of the catheter.⁴

⁴Bender, et al. 2006.

⁷Abdel-Aal, et al. 2014.

HYDROTHORAX

Description	The presence of peritoneal dialysis fluid in the pleural cavity, typically early in treatment as it is most frequently due to congenital defects of muscle fibers in the diaphragm ^{1,10}
Incidence	<ul style="list-style-type: none">▪ Range varies from 1.6 to 10%^{2,10}▪ More common in females¹⁰
Cause	Movement of dialysate, under increased intra-abdominal pressure, from peritoneal to pleural cavity through congenital or acquired defects in the diaphragm ²
Symptoms	<ul style="list-style-type: none">▪ Shortness of breath, decrease in effluent return, pain; most common on the right side¹¹▪ Pleural fluid: transudate, high sugar concentration, D-lactate present, LDH level low
Management	Thoracentesis for dyspnea or minimally invasive techniques such as pleurodesis or more invasive approaches using video-assisted thoracoscopic surgery (VATS). The treatment goal is to seal the porous diaphragmatic vent and allow full separation of the peritoneal cavity from the pleural cavity. Low pressure PD or stop PD and transition to temporary hemodialysis. Resumption of PD after repair is possible. ¹¹

¹McCormick and Bargman. 2007.

²Bender. 2012.

¹⁰Saha and Singh. 2007.

¹¹Guest. 2015.

HYDROTHORAX

- 33 year old female with sudden dyspnea & right chest pain approximately 5 weeks post-PD catheter
- Etiology
- Congenital diaphragmatic defect



Photo: Cho, et al. Acute hydrothorax complicating peritoneal dialysis: a case report. Journal of Medical Case Reports. 2010. 4:355.

HEMOPERITONEUM

Description	The presence of blood in peritoneal effluent, this is generally a benign complication of chronic PD. A small amount (2-3 ml) of blood in dialysate will make it appear bloody.
Incidence	More common in females and most common cause is menstruation in 41% and ovulation in 57% (Warn female patients ahead of time to avoid panic.)
Causes	<ul style="list-style-type: none">▪ Benign intraperitoneal bleeding (GYN, idiopathic, warfarin, etc.)▪ Serious causes: ischemia bowel, colon or urologic cancer, pancreatitis, encapsulating peritoneal sclerosis▪ Minor intraperitoneal bleeding with pathology (sclerosing peritonitis, peritonitis, pancreatitis, colonoscopy followed by anaerobic peritonitis)▪ Significant intraperitoneal bleed requiring intervention [ovarian cyst rupture, sclerosing peritonitis, polycystic kidney cyst rupture, tumor (liver, GI tract), amyloid spleen rupture, bleeding post PD catheter, etc.]
Symptoms	Dialysate appears bloody. Typically without other symptoms.
Management	<ul style="list-style-type: none">▪ Diagnosis by fluid cell counts and hematocrit for pathology. Ultrasound and CT for negative ultrasound.▪ Un-warmed 1.5% dextrose-containing dialysate for 1 to 3 rapid exchanges at home to vasoconstrict and establish hemostasis.▪ Hormonal therapy for women with excessive bleeding with menstruation.▪ IP heparin (500 or 1000 U/L) due to increased risk of PD catheter clotting in patients with hemoperitoneum.

¹⁰Saha and Singh. 2007.

REFERENCES

1. McCormick, B. B. & Bargman, J.M. (2007). Noninfectious complications of peritoneal dialysis: implications for patient and technique survival. *J Am Soc Nephrol.*, 18(12), 3023-5.
2. Bender FH.(2012). Avoiding harm in peritoneal dialysis patients. *Advances in Chronic Kidney Disease*, 19(3), 171-8.
3. Haggerty S, Roth S, Walsh D, Stefanidis D, Price R, Fanelli RD, Penner T, Richardson W, SAGES Guidelines Committee. (2014). Guidelines for laparoscopic peritoneal dialysis access surgery. Los Angeles (CA): Society of American Gastrointestinal and Endoscopic Surgeons (SAGES).
4. Abdel-Aal A, Dybbro P, Hathaway P, Guest S, Neuwirth M, Krishnamurthy V. (2014). Best practice consensus protocol for peritoneal dialysis catheter placement by interventional radiologists. *Perit Dial Int* , 34(5), 481–493.
5. Peppelenbosch A, van Kuijk WHM, Bouvy ND, van der Sande FM, Tordoir JHM. (2008). Peritoneal dialysis catheter placement technique and complications. *NDT Plus.*, 1(Suppl 4), iv23-i28.
6. Gokal, R., Alexander, S., Ash, S., et al., (1998). Peritoneal catheters and exit-site practices toward optimum peritoneal access: 1998 Update. *Perit Dial Int*, 18, 11-33.
7. Kelman, E. and Watson, D. (2006). Preventing and managing complications of peritoneal dialysis in Contemporary Nephrology nursing: Principles and Practice. 2nd ed. American Nephrology Nurses' Association. Pitman, New Jersey: Anthony J. Jannetti, Inc; 2006.
8. Bammens, B., Jeeters. D/. Kaelers. K., et al. (2014). Postimplantation X-ray parameters predict functional catheter problems in peritoneal dialysis. *Kidney Int.*, 86, 1001-1006.
9. Leblanc M, Ouimet D, Pichette V. (2001). Dialysate leaks in peritoneal dialysis. *Semin Dial.* 14(1), 50-4.
10. Saha TC, Singh H. (2007). Noninfectious complications of peritoneal dialysis. *South Med J.* 100(1), 54-8.
11. Guest S. (2015). The curious right-sided predominance of peritoneal dialysis-related hydrothorax. *Clin Kidney J.* , 8(2), 212-4.

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