

The background is a light gray gradient. It features several realistic water droplets of various sizes scattered across the surface. In the center, there is a faint, circular fingerprint pattern.

COMPLICATION PD

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Complications

- Infectious
- Non-infectious

Infectious complications

- Exit – site infection
- Tunnel infection
- Peritonitis: remains significant cause of
 - Hospitalization
 - PD failure
 - Damage to peritoneal membrane
 - Morbidity and mortality

Peritonitis

- Usual presentation is with
 - Abdominal pain and
 - Cloudy effluent fluid
- History
 - Recent break in technique
 - h/o peritonitis
 - Recent exit site infection
 - Diarrhea, constipation

How does bacteria gain entry into peritoneal cavity?

- During catheter connection
- Tracking around the catheter around the exit site
- Across the bowel wall; diverticulosis
- Transvaginal
- Rarely hematogenous
 - Bacteremia can cause peritoneal seeding and peritonitis
 - Peritonitis rarely causes bacteremia
 - Use antibiotic prophylaxis for anticipated bacteremia during procedures like dental work, colonoscopy, GU instrumentation
 - Drain effluent before colonoscopy or colposcopy

Diagnosis

- At least two of the following three features
 - Peritoneal fluid leucocytosis; >100 cells/mm³ and at least 50% PMNs
 - Abdominal pain
 - Positive culture of the dialysis effluent

Specimen collection and processing

- Effluent fluid sent for cell count with differential, culture and gram stain
- Collection of effluent: 50ml of effluent is centrifuged for 15 min followed by re-suspension of sediment in 3-5 ml of sterile saline and inoculation to media
- Dwell time of at least 2 – 4 hours before effluent collection
- If peritoneal cavity is dry, 1L of dialysate infused to dwell for at least 1 – 2 hours
- Peripheral blood cultures usually not necessary

Gram +ive organisms

- Coag neg Staph:
 - most common
 - secondary to touch contamination
 - Mild peritonitis, rapidly responsive to abx
- Staph aureus
 - Frequently associated with catheter infection
 - More virulent and resistant to abx
 - Anterior nares reservoir of staph aureus
 - Nasal carriers possibly at increased risk of exit site infection and peritonitis
- VRE
 - Risen dramatically
 - Also resistant to penicillin and aminoglycosides
- Group B strep
 - Rare cause, case reports
 - Can present with severe systemic symptoms including septic shock

Gram –ve organisms

- Non-pseudomonal gram –ve organisms: associated with
 - Touch contamination
 - Exit-site infection
 - Trans mural migration from constipation or colitis
 - Polymicrobial or anaerobic: due to diverticulitis or bowel perforation
- Pseudomonal peritonitis
 - Common at some centers where reduction in touch contamination peritonitis with techniques like flush before fill and prophylactic topical antibiotic
 - Difficult to eradicate
 - Severe infection can damage peritoneal membrane
 - Can be associated with catheter infection

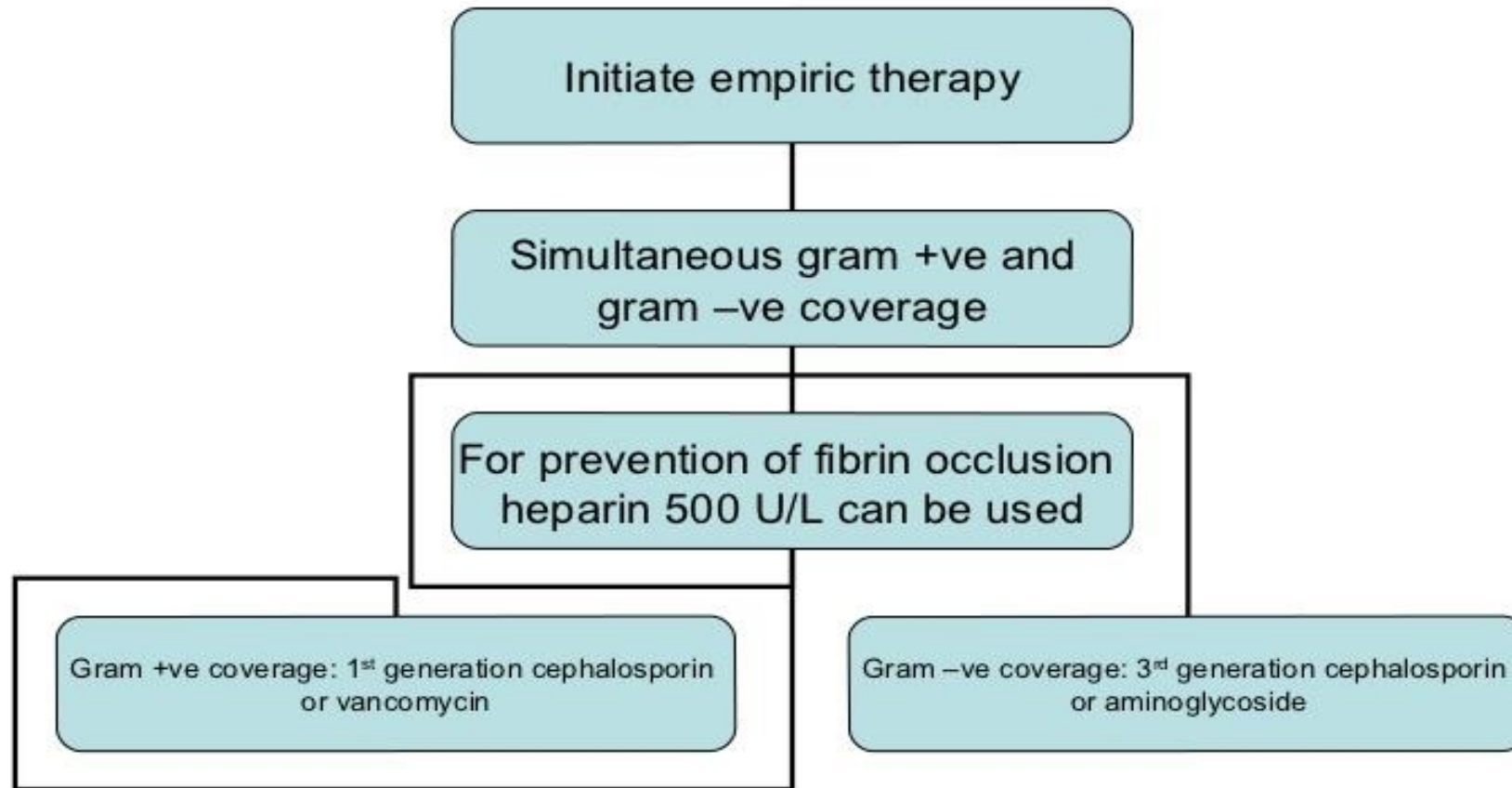
Treatment

- Majority of peritonitis resolve with outpatient antibiotics treatment alone
- Antibiotics with or w/o fibrinolytic agents. Few cases need catheter removal
- In 2005 International Society of Peritoneal Dialysis (ISPD) working group established a series of peritonitis treatment guidelines
- In 2007 systematic review of 36 RCT was performed addressing the efficacy of abx and other factors
 - No specific antimicrobial regimen was superior
 - Intermittent and continuous dosing were largely equivalent
 - 1st generation cephalosporins and glycopeptides had equivalent efficacy
 - In cases with suspected catheter infection, simultaneous catheter removal resulted in treatment success
 - The trials were limited by small patient number and inconsistent outcome definitions

Treatment

- Non-antimicrobial measures
 - Heparin 500 units/L can be used to lyse or prevent fibrin clots when dialysate remains cloudy
 - Pain control
- Dwell time
 - Long dwell exchanges (4-6 hrs) when compared with short dwells are associated with higher number of functional macrophages
- Membrane properties: changes during peritonitis
 - Patients may transiently become rapid transporters, thereby requiring the use of hypertonic glucose or shorter dwells
 - Alternatively, icodextrin may be helpful

Empiric Therapy



Empiric therapy

- 1st generation cephalosporin: cefazolin or cephalothin
- Vancomycin used at centers with high rate of MRSA
- 3rd generation cephalosporin: ceftazidime or cefepime
- Short term use of aminoglycoside is safe and does not diminish residual renal function
- Aztreonam can be used in cephalosporin allergic patients
- Monotherapy with imipenem/cilastatin is possible. One study with 102 patients randomly assigned to either imipenem/cilastatin or cefazolin + ceftazidime showed similar outcomes in both groups

Other causes of peritonitis

- Fungal peritonitis
 - Catheter removal
 - Flucytosine 1gm/day + Fluconazole 200 mg/day PO for 10 days after catheter removal
- Mycobacterial peritonitis
 - M. tuberculosis: Rifampin + INH (for 12 months) + pyrazinamide + ofloxacin (3 months)
 - Consider catheter removal

Intermittent dosing of antibiotics in APD

- Cefazolin (IP): 20 mg/kg every day, in long dwell
- Cefepime (IP): 1 gm in one exchange per day
- Vancomycin (IP): loading dose 30 mg/kg in long dwell, repeat dosing 15 mg/kg in long dwell every 5-7 days
- Fluconazole (IP): 200 mg in one exchange per day every 24-48 hours

Catheter removal in peritonitis patients

- 2005 ISPD guidelines recommend catheter removal in following
 - Relapsing peritonitis: another episode with same species that caused the preceding episode within 4 weeks of completing abx
 - Refractory peritonitis: failure to respond to abx in 5 days
 - Refractory catheter infection
 - Fungal peritonitis
 - Fecal peritonitis
 - Peritonitis associated with intra-abdominal pathology
- Consideration to catheter removal in mycobacterial and multiple enteric organisms peritonitis

Other causes of cloudy effluent

- Eosinophilic peritonitis
- Chyloperitoneum
- Fluid that's been dwelling for a long time



Eosinophilic peritonitis

- Relatively new PD catheter
- Effluent is cloudy w/o abdominal pain
- PD differential count: eosinophils ++
- Effluent culture: no growth
- Cause: ?immune reaction to catheter
- Treatment
 - Usually self limited, goes away in few days
 - Some reports of benefit with IP steroids

PD catheter removal after transplant

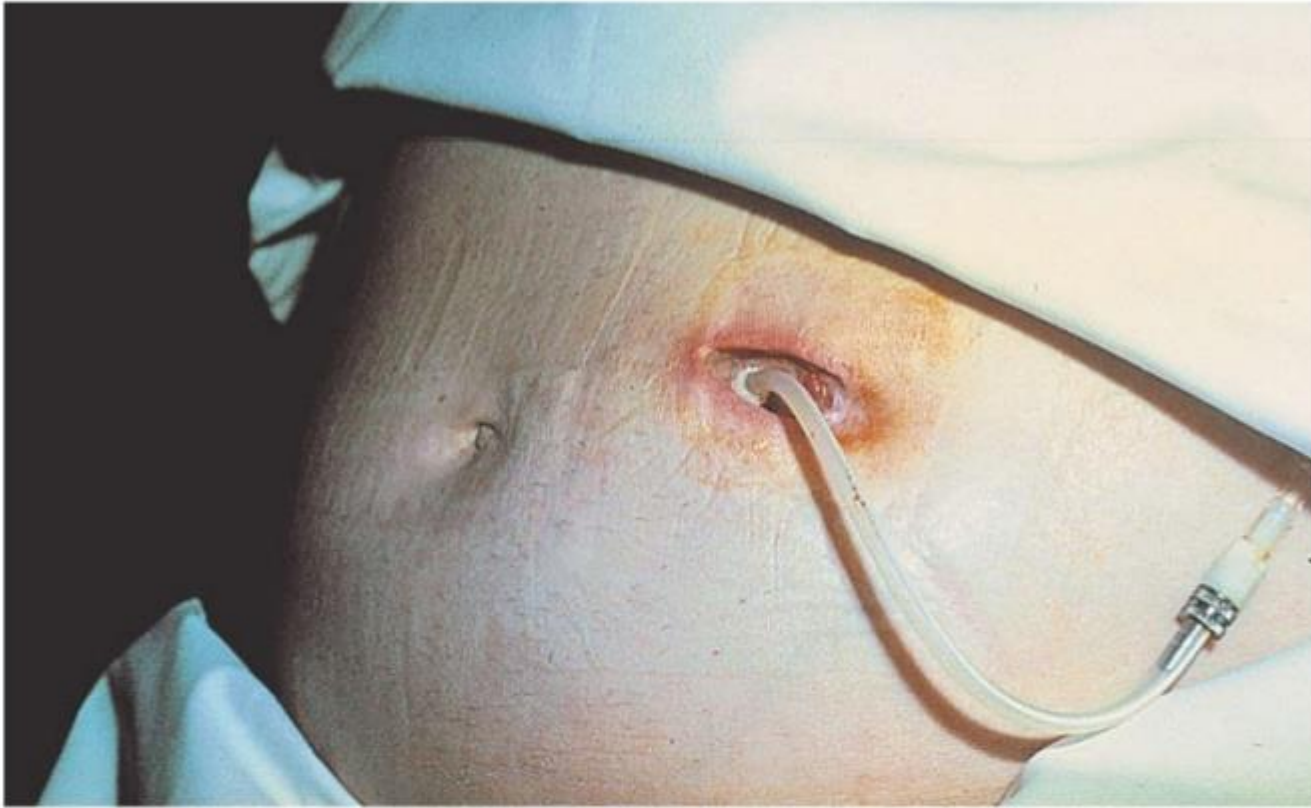
- Optimal time after transplant is unclear
- Some clinicians wait 3 – 4 months after transplant for catheter removal
- Early catheter removal is advised in high-risk patients

Other causes of abdominal pain in PD patients

- Ischemic bowel
- Pancreatitis
- Cholecystitis
- Pyelonephritis
- Nephrolithiasis
- Constipation
- Incarcerated hernia
- Appendicitis
- Diverticulitis
- Ruptured viscus

Exit-site/Tunnel infection

- Exit-site infection: presence of purulent discharge with or w/o erythema of the skin at catheter-epidermal interface
- Tunnel infection: usually occult but may be present with erythema, edema or tenderness over subcutaneous path
- Rarely occurs alone
- Staph aureus and pseudomonas exit site infections are often associated with concomitant tunnel infection

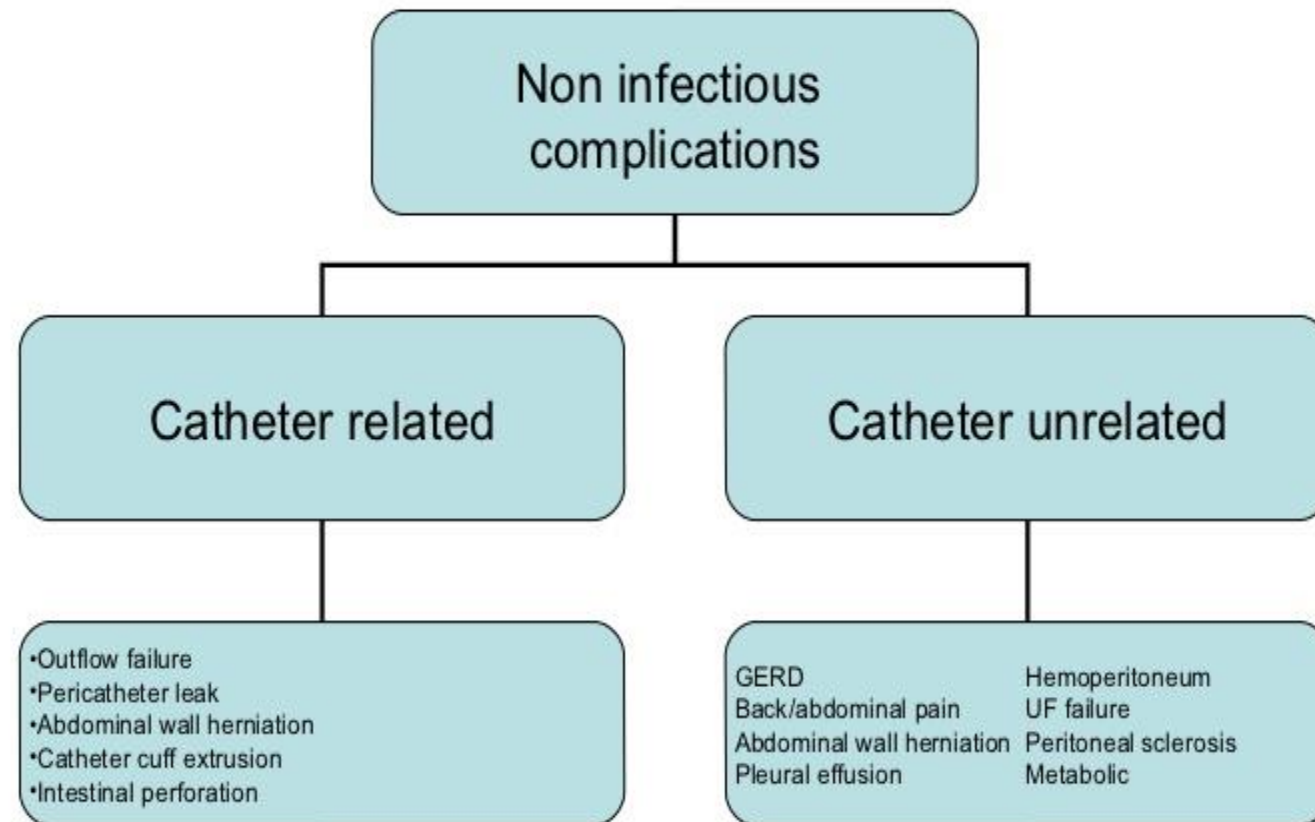


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Non-infectious complications

Non-infectious complications



Outflow failure

- Incomplete recovery of instilled dialysate
 - Unable to remove dialysate from peritoneal cavity
 - Fluid is no longer in peritoneal cavity
- Incidence: 5-20%
- Etiologies
 - Constipation (anytime)
 - Catheter malposition (days)
 - Intraluminal catheter occlusion by thrombus
 - Extraluminal catheter occlusion by omentum or adhesions (weeks)
 - Kinking (soon after placement, positional)
 - Loss of dialysate from peritoneal cavity

Diagnosis

- History
 - Flow disturbance – inflow, outflow or both
 - When was the catheter placed
 - Constipation
 - Pain
 - Dyspnea
 - Fibrin in dialysate drain
- Plain film
 - Severe constipation
 - Catheter malposition
- Lost dialysate: peri-catheter dialysate leakage; either internal or external

Treatment

- Constipation
 - More than half of the cases are cured with relief of constipation
 - Laxatives, stool softeners, suppositories or enema
- Fibrin clot
 - Heparin 500 units/L of dialysate for lysis
 - Urokinase – instilled in catheter for 1 hour and then removed
 - Recombinant tPA – used if obstruction is refractory

Treatment

- Malpositioned catheter
 - Fluoroscopy with stiff wire manipulation
 - Redirection either laproscopically or surgically
 - Replace catheter if not successful
- Catheter kinking
 - Usually requires catheter replacement
 - Superficial cuff removal if kinking is due to placement of the catheter cuffs too close to each other
- Abdominal exploration may be necessary for catheter redirection, omentectomy or adhesiolysis or catheter replacement

Pericatheter leakage

- Early after placement
- Increased intra-abdominal pressure on CAPD
2ry to increased activity
- Weak abdominal wall (pervious surgeries, pregnancies)
- High dialysate volumes
- Catheter placement techniques: poor evidence of technique with incidence
 - Peritoneoscopically placed catheters may be better
 - Double cuff catheters are considered less likely to leak

Pericatheter leakage

- Clinical features
 - Subcutaneous swelling
 - Fluid in area surrounding the catheter
 - Genital and abdominal wall edema
 - Diminished outflow volumes
- Diagnosis
 - Check glucose concentration of fluid around the catheter to determine if it is dialysate or serous fluid from subcutaneous tissue
 - For confirmation – peritoneal scintigraphy, CT scan or MRI after dialysate infusion using dialysate as a contrast

Pericatheter leakage

- Treatment
 - Reduce physical activity
 - Reduce dialysate volumes
 - Conversion to cyclor
 - Temporary conversion to HD
 - If conservative measures fails then surgical repair of deep cuff or catheter replacement

Pleural effusion

- Possible etiologies:
 - Volume overload, CHF
 - Local pleural process
 - Peritoneal dialysate
- Suspicion of peritoneal dialysate in a non edematous pt with inadequate UF
- Incidence: 1.6%, more common in females
- ADPKD patients prone to have due to decreased abdominal capacity

Pleural effusion

- Usually occurs early after starting PD
- Unrelated to dialysate volumes
- Hypotheses:
 - Congenital communication between pleura and peritoneum. Dissection of fluid through defects around major vessels and the esophagus
 - Combination of increased intra-abdominal pressure and negative intra-thoracic pressure may open small defects in the diaphragm

Pleural effusion

- Clinical features
 - Can be asymptomatic
 - Dyspnea on exertion
 - Inadequate UF
 - More common on right side
 - Occurs early after PD initiation, 50% of cases within 1st month
- Diagnosis: high glucose concentration in pleural fluid

Pleural effusion

- Treatment: depends on acuity and severity
 - Thoracentesis
 - Drain peritoneal cavity and avoid overnight supine dwells
 - If recurrent and unresponsive: chemical pleurodesis using talc, tetracycline or autologous blood
 - Surgical correction if diaphragmatic defect is identified
 - Temporary conversion to HD

Catheter cuff extrusion

- Catheter cuff erodes through the skin to the outer abdominal wall
- Can be 2ry to exit-site infection or superficial cuff placement
- Incidence: 3.5 – 7%; no specific association with catheter type and method of placement
- Treatment: depends on presence or absence of infection
 - No infection: extruding cuff removed by opening the subcutaneous tissue at exit site and trimming the cuff under sterile conditions
 - Infection present: remove the catheter

Intestinal perforation

- Direct injury during catheter placement
- By erosion – weeks to months after catheter placement
- Requires high index of suspicion
- Incidence: rare (<1%); more common with semi-rigid PD catheters
- Clinical features
 - Bloody or feculent dialysate
 - Dialysate retention
 - Diarrhea after dialysate instillation
 - Gram negative peritonitis
- Treatment: surgery
 - Bowel repair, catheter removal and antibiotics

Bleeding exit-site

- Etiology
 - Trauma to small blood vessels after catheter placement
 - Crust removal before natural separation occurs
 - Exit-site infection with secondary hemorrhage
- If possible avoid peri-op anticoagulation for 24 hours

Hemoperitoneum

- Benign causes
 - Menstruation
 - Ovulation
 - Trauma
 - Coagulopathy
 - Ruptured renal or ovarian cyst
- Serious causes
 - Ischemic bowel
 - Colon cancer
 - Pancreatitis
 - Encapsulating peritoneal sclerosis
 - Urologic malignancy

During training, warn females in advance!

Hemoperitoneum

- Treatment
 - IP heparin to avoid clotting of catheter
 - Flushes
 - Investigations depend on suspected cause and type of presentation

GERD and delayed gastric emptying

- GERD: Clinical features
 - nausea, vomiting, fullness or discomfort
 - 24 hours pH monitoring has shown abnormalities after dialysate instillation in symptomatic patients
- Delayed gastric emptying: mechanical or neurogenic mechanism triggered by the presence of intra abdominal fluid
- Treatment:
 - GERD: minimize supine intraperitoneal fluid volume
 - Delayed gastric emptying: metoclopramide or erythromycin, case report of IP ondansetron in a patient with refractory symptoms

Back pain

- Can be 2ry to increased mechanical stress on lumbar spine (lardotic position)
- May be associated with other musculoskeletal disease
- Treatment
 - Decrease dialysate fill volumes
 - If inadequate dialysis, may need to change to cycler (APD). Pt may tolerate larger fill volumes while supine

Hernia

- Treatment
 - Surgical repair
 - No PD for 2 days after surgery, then back on cyclor, day dwell can be re-introduced in 2 months
 - No need for interim HD
- Perioperative management of peritoneal dialysis patients undergoing hernia surgery w/o the use of interim HD; Shah et al, Perit Dial Int 2006; 684-687

Dialysate infusion pain

- Causes
 - Peritonitis
 - Patient new to PD. Pain diminishes during dwell
 - Acidic ph of conventional lactate dialysate
 - Catheter position abutting bowel wall
 - Dialysate temperature
 - High dialysate glucose concentration
- Treatment
 - Slow infusion rate
 - Dialysate with higher ph eg bicarb or bicarb/lactate
 - Injection of local anesthetic into dialysate before infusion eg 1% lidocaine; 50mg/exchange
 - Incompletely drain the fluid after a dwell period
 - Rarely catheter replacement or conversion to HD

Metabolic

- Hypokalemia
 - 10 – 35% of PD patients require K supplements
 - Hypokalemia can be due to increased cellular K uptake secondary to insulin secretion after glucose load
 - Liberalize dietary K intake
- Hypermagnesemia
 - More common in PD than HD
 - Results from high Mg in dialysate (0.75 mmol/L)
 - Consider other dialysate conc (with Mg 0.5 or 0.25 mmol/L)
 - Avoid Mg containing medications