Brigham and Women's Hospital
Founding Member, Mass General Brigham

# Complications of Peritoneal Dialysis

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# Disclosures

DaVita Healthcare:  Speaker and Consultant
Baxter Canada:  Speaker and Consultant
Baxter Global:  Speaker
Opterion: Consultant

# Learning Objectives

Using real cases, we will discuss

- approach to problems with the PD catheter
- infectious complications
- hernias and leaks
- bloody effluent

# Mrs. BaD Karma

- 33 year old woman with postpartum renal failure
- no appropriate kidney donor
- attends dialysis education class and chooses home peritoneal dialysis
- PD catheter inserted by laparoscopy:  good flow in the OR

# Mrs. BaD Karma

- comes to peritoneal dialysis unit to begin training
- dialysate infuses easily, but very slow outflow
  - first 500 mls takes about 30 minutes, and then the flow stops

# Catheter-Related Problems

These usually occur soon after implantation:

- 2-way obstruction
  - problem with inflow and outflow
- 1-way obstruction
  - good inflow, poor outflow
- painful inflow or outflow

# What is *Not* Necessarily a Problem…

First ever exchange:

- 1 liter good inflow
- 500 ml good outflow

WHY?

# Catheter-Related Problems

## 2-way obstruction

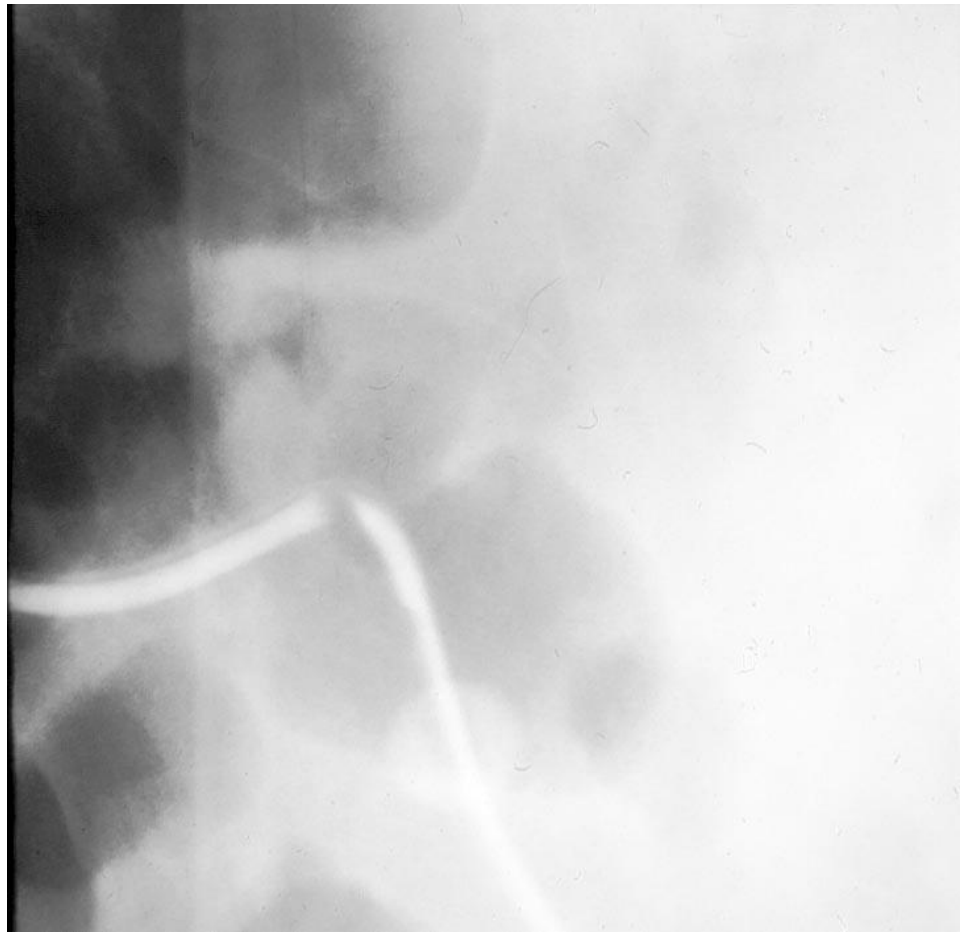
- kink or bend in catheter
- intraluminal obstruction (blood clot, fibrin)

## Treatment

- vigorous flush with heparinized saline, insertion of brush into catheter lumen (should be done only by experienced personnel)

# Fibrin Plug

# Catheter Dye Study:  Kink in Catheter



# Catheter-Related Problems

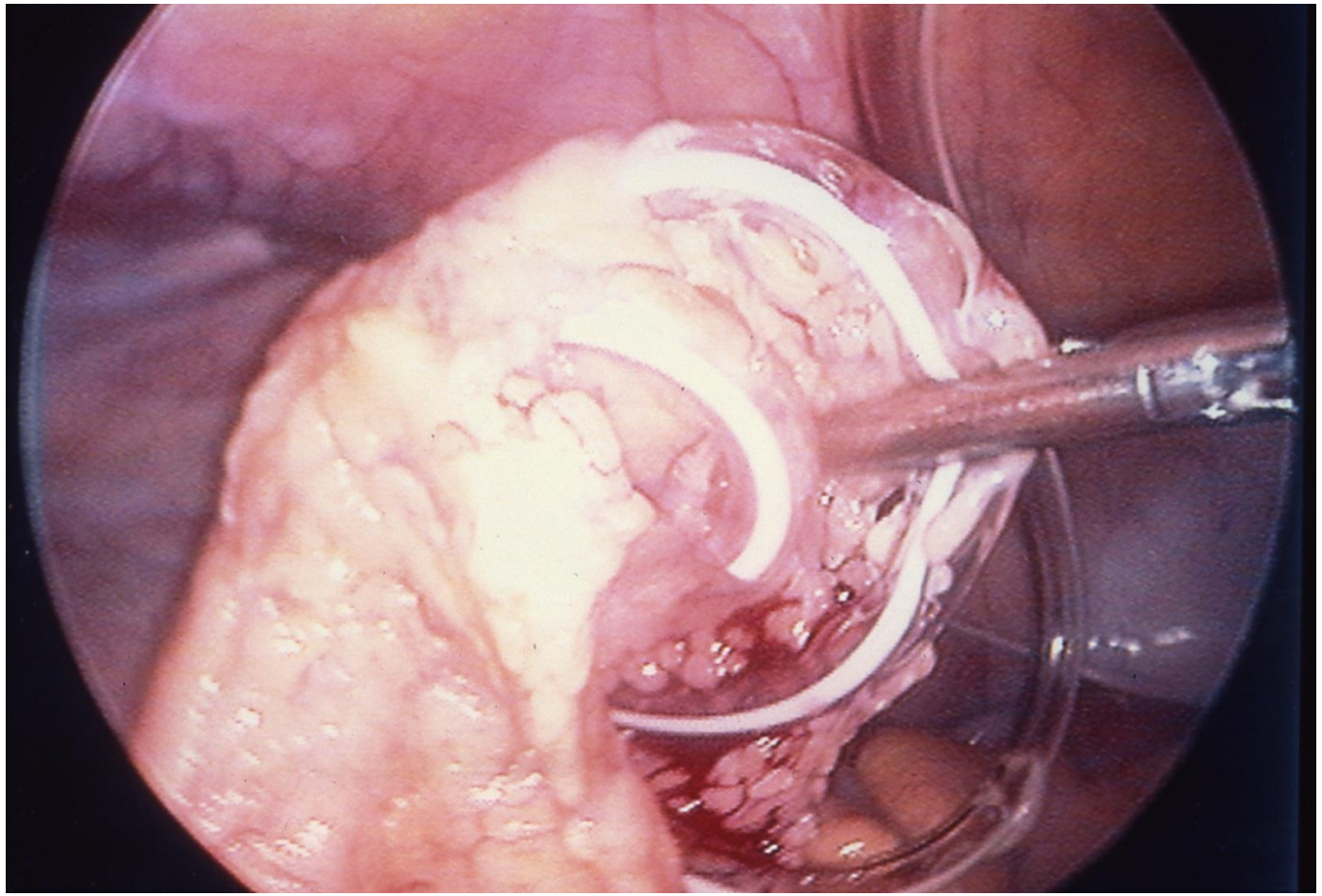
## 1-way obstruction (good inflow, poor outflow)

- constipation ***
- catheter migration into upper quadrants or into a loculated pocket
- omental wrap
- Fallopian tube wrap

•treatment

- careful attention to bowel cleanout ***
- radiologic or laparoscopic manipulation of catheter
- surgical removal of omentum or laparoscopic omentopexy

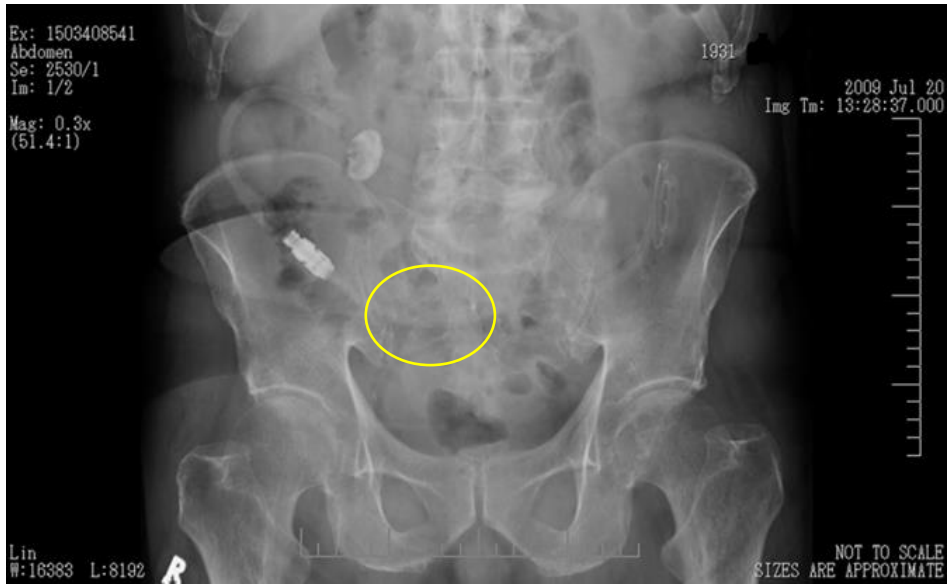
# Omental Wrap



Slide courtesy of Dr. J. Crabtree

# Mrs. BaD Karma

Her abdominal flat plate shows:
lots of stool in the large bowel
catheter tip in the middle quadrant



# Mrs. Karma

- she is given lactulose and a tap water enema, and you are told that there are “good results”

Are you happy?

a. Yes
b. No

# Why Are We Not Happy?

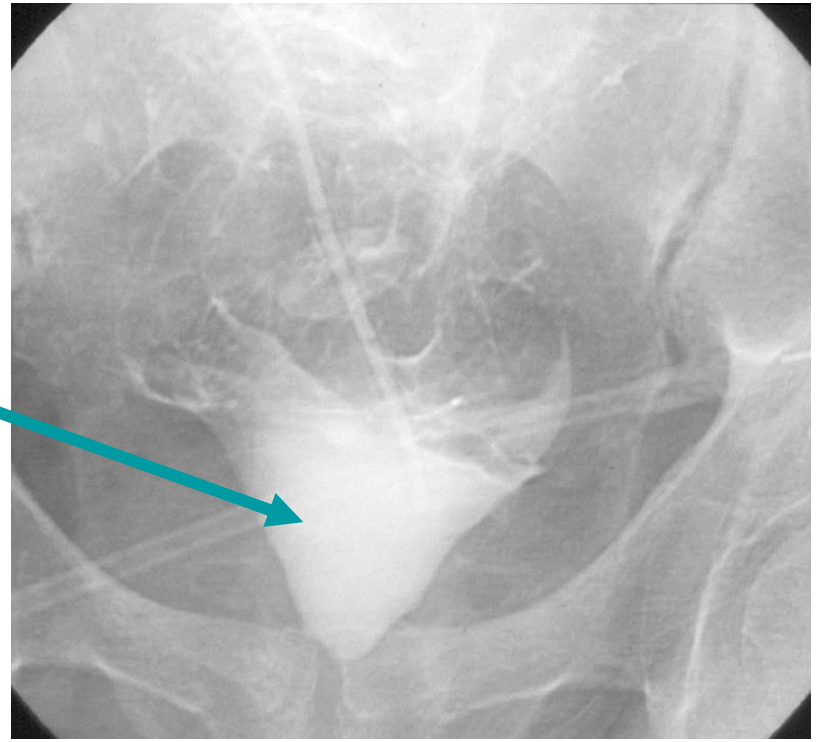
- one bowel movement may just empty the rectum
- there may be 15 bowel movements lined up behind it

# Mrs. Karma

- she is sent home for the weekend with lactulose and senna
- over the weekend she has 8 more bowel movements
- *still* no improvement in outflow

# Catheter Dye Studies

- inject enough dye to fill catheter and spill into peritoneal cavity
- what you can diagnose:
  - kink in catheter
  - obstruction within lumen
  - peritoneal compartment problem



# Mrs. B.D. Karma

Catheter dye study not diagnostic

- discussed with patient: patient chose to continue with PD
- laparoscopic removal of fallopian tube from around catheter

Finally: catheter outflow improved dramatically!

# Approach to Post-Insertion Catheter Dysfunction

- Understand if it is one-way or two-way obstruction
- if two-way: flat plate +/- catheter dye study (kink, intraluminal clot)
  - can attempt catheter irrigation
- if one-way: abdo flat plate
  - you will likely see +++ stool and catheter may or may not be out of the pelvis

# Approach to Post-Insertion Catheter Dysfunction *(cont'd)*

1. First of all:  clean out the bowels (this may entail a lot of bowel movements!)
2. Recheck catheter outflow
3. If no improvement
   - another abdominal flat plate
4. If catheter tip is in the right place
   - ? omental wrap
   - ? tip not connecting with peritoneal cavity
   - make sure no more stool

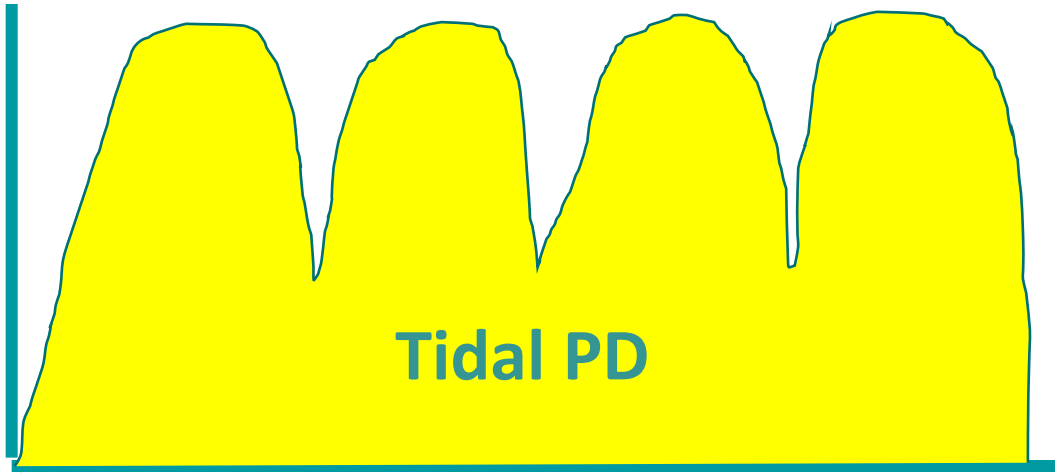
→ proceed to catheter dye study or diagnostic laparoscopy

# Painful Inflow and Outflow

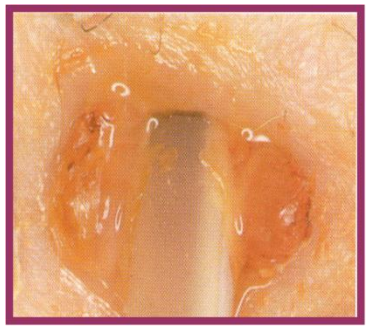
## both can usually be treated by “tidal” PD:

- leave in a residual dialysate volume and cycle a smaller volume
  - eg 2L inflow, 1.7 L exchanges (I have occasionally used 50% tidal)

(sometimes constipation will cause or exacerbate painful flow)



# The Yucky Exit Site



- Mr. EZ is on PD X 2 years
- usual exit site care, including daily mupirocin
- presents with redness and pus around the exit site
- swab shows *Serratia Marcesens*

# The Yucky Exit Site

## What is The Best Course of Action?

a) Remove the PD catheter and change to hemo for 4-6 weeks
b) Remove the PD catheter and replace with a new catheter at the same OR
c) Change the exit site ointment to gentamicin
d) Change the exit site ointment to fluconazole

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# Prevention of Exit Site Infection

- regular application of antibiotic ointment to the catheter exit site is associated with a significant reduction in exit site infection and (in some studies) peritonitis
- the unknowns:
  - development of antibiotic resistance
  - effect of ointment/cream on catheter integrity
  - overgrowth of fungus

# Gentamicin at the Exit Site: Yeast Overgrowth

2 of my patients who received gentamicin at the exit site for gram negative cultures

# Mr. G.W.

- 68 year old Type II diabetic
- 3 recurrent episodes of coagulase negative staph peritonitis in 5 months
- re-trained
- 2 weeks later presents with peritonitis
  - culture grows *Candida parapsilosis*

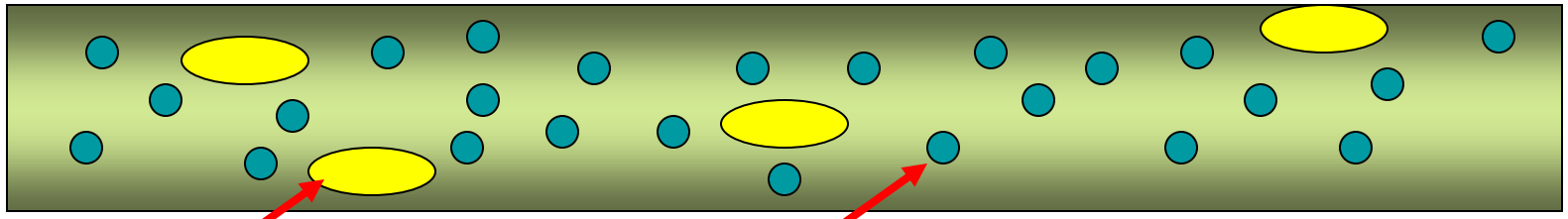
# Fungal Peritonitis – A Serious Complication

- accounts for 1 – 15% of peritonitis episodes
- technique failure in many (> 40%)
  - But 35% in our cohort successfully returned to PD
- mortality rate 5 – 53% (frail patients)

# Risk Factors for Fungal Peritonitis

- frequent peritonitis **
- antibiotic therapy **
- immunosuppression
- peritoneo-vaginal communication

# Antibiotic Therapy as a Risk Factor for Fungal Peritonitis

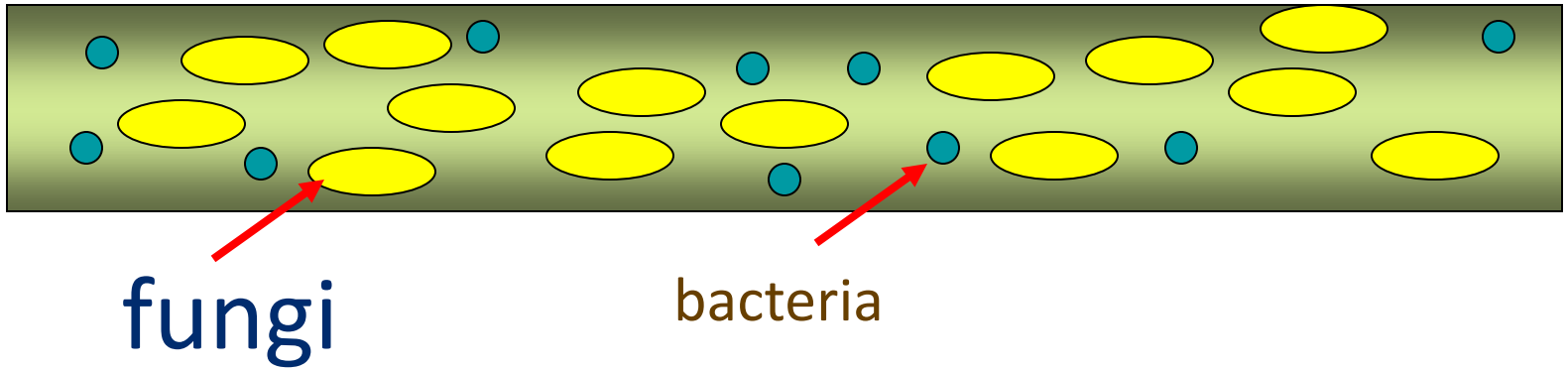


fungi

bacteria

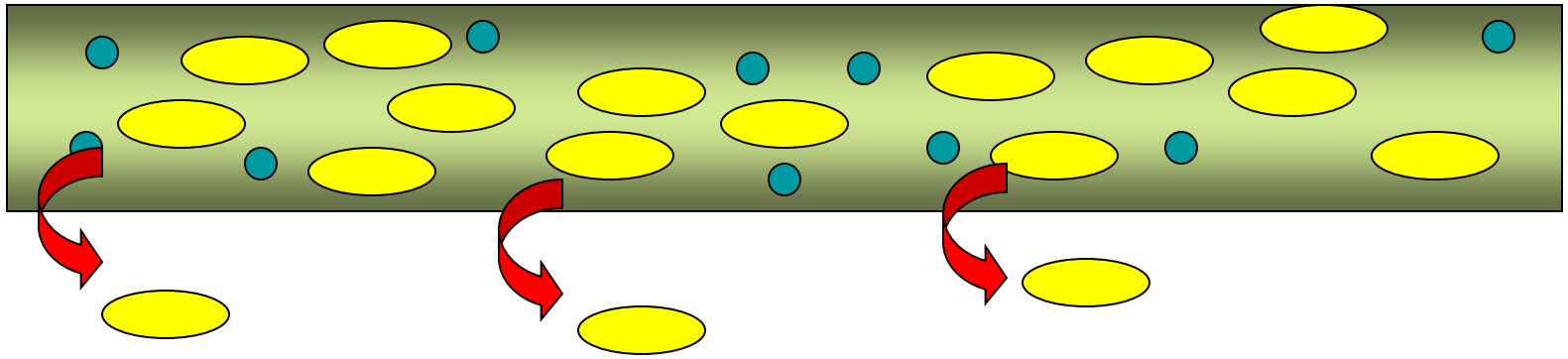
*Then add antibiotics to the mixture…*

# Antibiotic Therapy as a Risk Factor for Fungal Peritonitis – with antibiotics




*Fungal overgrowth of the intestine (and other sources?)*

# Antibiotic Therapy as a Risk Factor for Fungal Peritonitis – with antibiotics



*Overgrowth of fungi leads to migration out of bowel and into peritoneal cavity?*

# Anti-Fungal Prophylaxis

- success rate of prophylaxis will depend on baseline rate of fungal peritonitis
- units with high rates have demonstrated reduction of fungal peritonitis rates with prophylactic anti-fungal therapy
- oral nystatin may be inconvenient, but safe
- can also use fluconazole

# Fungal Peritonitis: After Catheter Removal, then What?

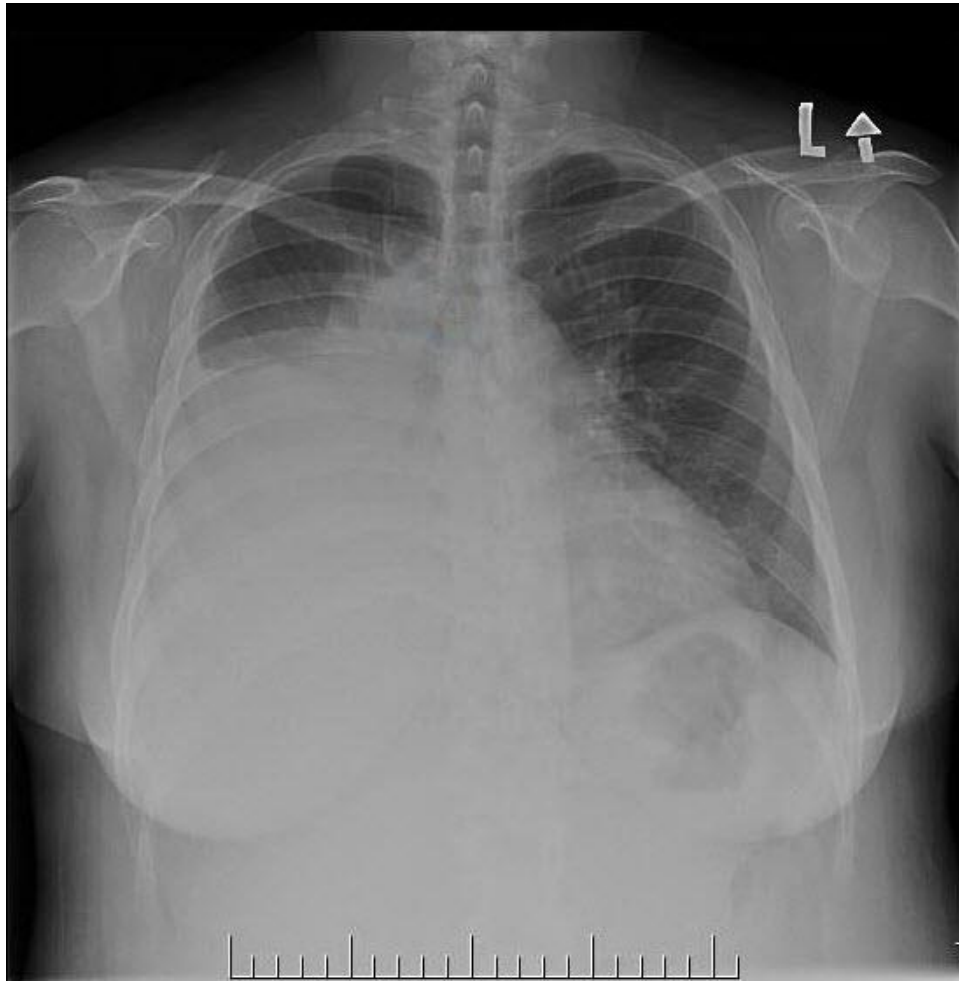
- interim hemodialysis
- for how long?
  - no one knows
  - 1-3 months?
- in our experience, 1/3 of the patients successfully returned to PD

Nadeau-Fredette Perit Dial Int 2015

# Mrs. Karma's Breathing Problems

- after her laparoscopic salpingolysis for Fallopian tube wrap, she is trained and discharged on APD, 2L X 3 exchanges over 8 h, 1.5L last fill
- 3 days later, she calls the unit, complaining of progressive shortness of breath
  - mild cough, but no fever or sputum
  - weight is increased 1 kg, but no edema nor change in blood pressure
  - a chest x-ray is ordered

# Mrs. Karma's Chest X Ray



# Hydrothorax

Definition: The presence of peritoneal dialysis fluid in the pleural cavity

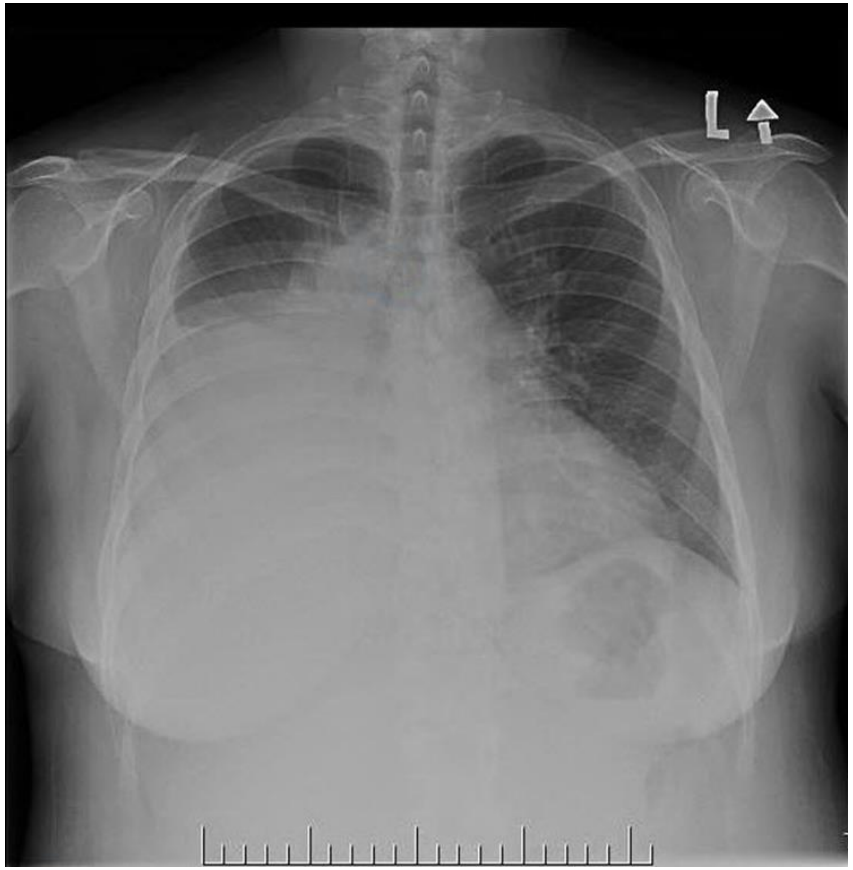
Incidence: Probably < 5%

Pathogenesis: Movement of dialysate, under increased intra-abdominal pressure, from peritoneal to pleural cavity through congenital or acquired defects in the diaphragm

# Hydrothorax

Presentation:

- may be asymptomatic
- shortness of breath
- diminished effluent return
- right-sided pleural effusion on CXR



# Hydrothorax

- thoracentesis for relief of symptoms and/or diagnosis
- pleural fluid analysis:
  - transudate
    - very high glucose concentration (usually, *but not always*)
    - cell count variable
- don't use intraperitoneal methylene blue

# Hydrothorax - Treatment

- thoracentesis may be helpful if very SOB
- stop PD
  - temporary hemodialysis,  if dialysis needed
  - have a talk with the patient about returning to PD
- if patient wants to pursue PD:
  - pleurodesis (talc, tetracycline, bleomycin, autologous blood)
  - operative or pleuroscopic repair (diaphragmatic defects identified and patched or oversewn)

# Mrs. Karma Gets Belly Pain

- after successful pleurodesis, Mrs. Karma returns to PD
- 4 years later she experiences crampy abdominal pain and cloudy PD fluid, afebrile

# Which ONE of the Following is TRUE?

A. Given the absence of fever, this pain is not likely due to PD peritonitis
B. Typical PD peritonitis rates average about 1 episode a year in most centers
C. There is an approximate 20% risk of bacteremia resulting from PD peritonitis
D. Empiric coverage should be given for both gram positive and gram negative organisms

# Peritonitis - Diagnosis

The diagnosis of peritonitis requires at least 2 of the following 3 features:

- peritoneal fluid leukocytosis (>100/$mm^3$, and at least 50% polymorphonuclear cells)
  - the fluid should dwell 2 to 4 hours
- abdominal pain
- positive culture of the dialysis effluent

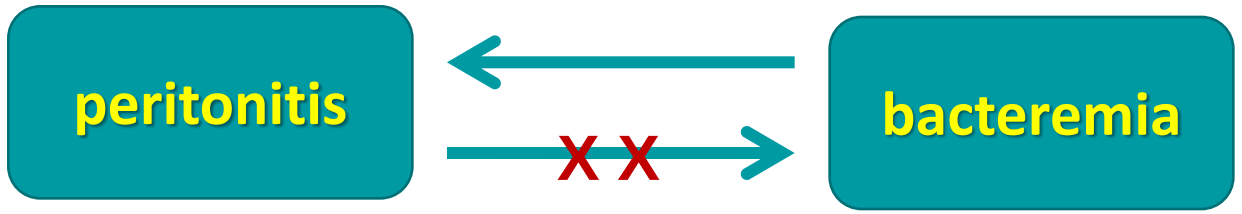
# Hematogenous seeding

•bacteremia can cause peritoneal seeding and secondary peritonitis

but

***peritonitis hardly ever causes bacteremia***

(keep this in mind if you have a patient with a mechanical heart valve or prosthetic hip)



# Hematogenous seeding

Use antibiotic prophylaxis at times of anticipated bacteremia

eg dental work, endoscopy (upper and lower), colposcopy or GU instrumentation (and drain effluent before the procedure)

# Peritonitis - Principles of Treatment

- start antibiotic treatment quickly
- cover for both gram positive and gram negative organisms until cultures available
- adjust antibiotics according to culture results
- re-evaluate the treatment if no improvement* in 36-48 hours
  - * less abdominal pain, falling peritoneal fluid WBC count

# Peritonitis - Principles of Treatment

- consider removal of the PD catheter if little or no improvement in 4-5 days (especially if staph. aureus or pseudomonas)
- fungal peritonitis:  catheter removal as soon as possible

*don’t let peritonitis drag on for days **!***

# Most Recent Guidelines: Find them at www.ispd.org

*Special Series/Guidelines*

PERITONEAL DIALYSIS INTERNATIONAL

## ISPD peritonitis guideline recommendations: 2022 update on prevention and treatment

Peritoneal Dialysis International
2022, Vol. 42(2) 110–153

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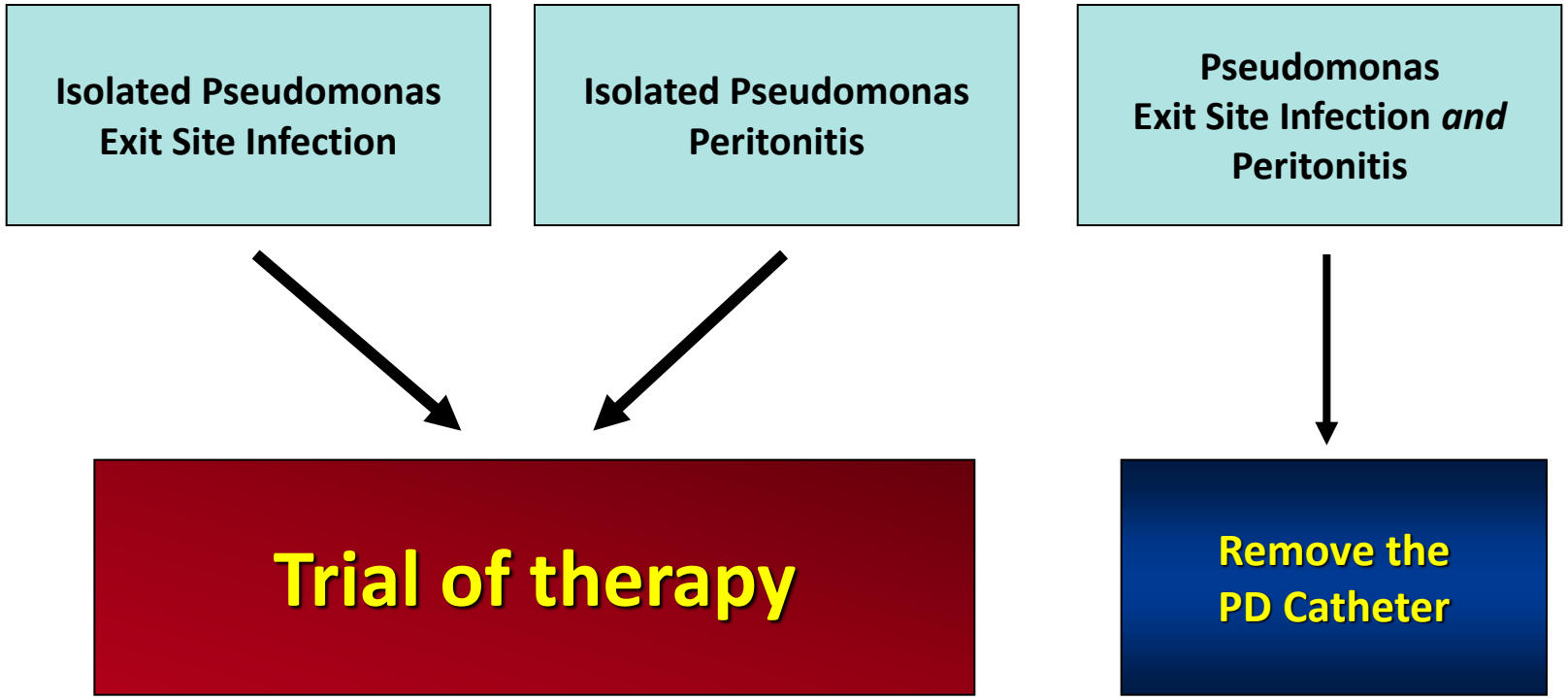
Philip Kam-Tao Li[1,2], Kai Ming Chow[1,2], Yeoungjee Cho[3,4], Stanley Fan[5], Ana E Figueiredo[6], Tess Harris[7], Talerngsak Kanjanabuch[8,9], Yong-Lim Kim[10], Magdalena Madero[11], Jolanta Malyszko[12], Rajnish Mehrotra[13], Ikechi G Okpechi[14], Jeff Perl[15], Beth Piraino[16], Naomi Runnegar[17], Isaac Teitelbaum[18], Jennifer Ka-Wah Wong[19], Xueqing Yu[20,21] and David W Johnson[3,4]

# Special Cases: Pseudomonas Peritonitis

- combine 2 anti-pseudomonal antibiotics for 21 days
- if pseudomonas peritonitis is in association with pseudomonas exit site or tunnel infection, remove catheter

# Pseudomonas Infection



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D. Empiric coverage should be given for both gram positive and gram negative organisms

# Explanation

- Fever is present in about 50% of patients with PD peritonitis
- Most units will have peritonitis rates of 1 episode every 36 months or better (our rate is 1 episode every 60-70 months)
- PD peritonitis rarely rarely leads to bacteremia

# Risk for Technique Failure After Peritonitis

- 9100 episodes across 51 centers
- cure rate varied from 38% to 69%
- predictors of higher cure rate
  - higher % of patients on PD
  - empiric antibiotics covering Gm+ and Gm –
- units with greater % of patients on PD also had lower odds of catheter removal and lower transfer to HD

*center-specific characteristics were more important than patient-specific characteristics*

Htay et al Am J Kidney Dis 2017

# Mr. C the Building Superintendent

48 year old man with polycystic kidney disease is trained on cycler dialysis.  Current prescription is 2.0 L X 3 exchanges over 8 hours at night, with 2.0 L day dwell

- one year later: he is doing well
- residual kidney GFR is 8 ml/min
- his wife is almost finished being worked up as a kidney donor

# The Building Superintendent

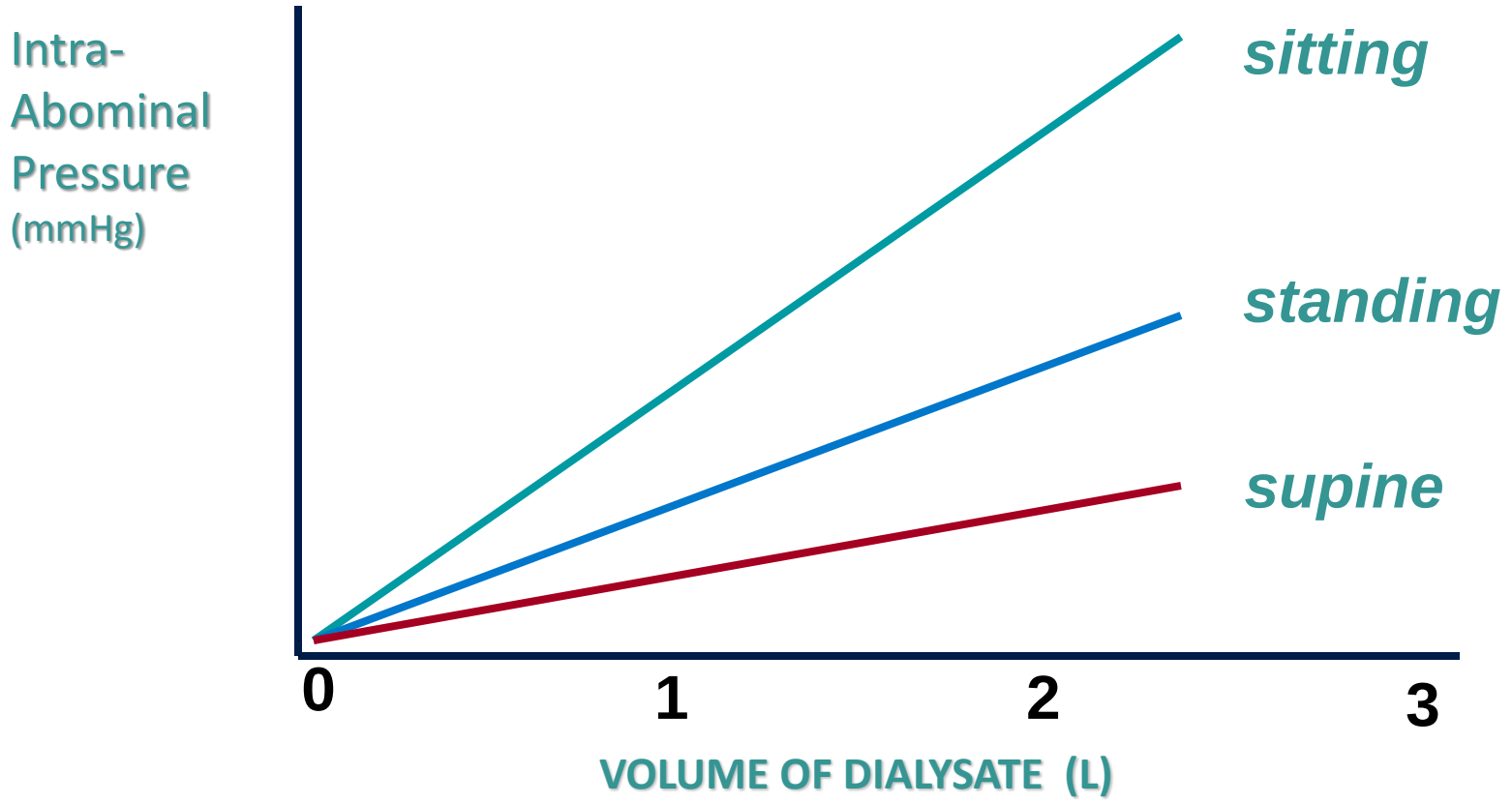
- at clinic, he reports a new “lump” in his left groin.
- he had been bent over looking under a sink and felt a “pop” and some tenderness in the groin
- on physical exam, there is a left inguinal hernia

# PD and Increased Intra-abdominal Pressure (IAP)

- instillation of dialysate into the peritoneal cavity leads to increased IAP
- the magnitude of the increase depends upon:

  -volume of dialysate instilled
  -position of the patient (sitting>standing>supine)
  -age, body mass index
  -coughing, lifting, straining at stool, aerobics class, chopping wood

# Relationship among Intra-Abdominal Pressure (IAP), Position & Dialysate Volume



# Ventral Hernias

# Umbilical Hernia

# Inguinal Hernia

# Treatment of Hernias

- warn patient about signs of incarceration

- surgical repair:

  - dialysis around repair depends on renal function and condition of the patient
  - don't usually have to put them on HD !
  - reintroduce PD with low volumes, supine posture, increase volume over 2 weeks

- The exception to keeping them on PD over the hernia repair: bowel compromise (incarceration and/or strangulation)

Shah H, Chu M and Bargman JM
Perit Dial Int 2006

# So What Happened to Our Superintendent?

- changed to night cycler dialysis
- dry during day (RKF 8 ml/min)
- elective hernia repair
- no PD for 2 days
- back to night cycler 1.5L volume X 2 weeks, then 2Lvolume overnight
- elected not to resume day dwell for now, given his good RKF

# Abdominal Wall and Genital Edema

- abdominal swelling or bogginess, scrotal or labial edema
- diminished effluent return
- weight gain without peripheral edema
- pericatheter leak:  wetness or swelling at exit site

# "*Peau d'orange*" of Abdominal Wall Edema

# Abdominal Wall Leak Due to Umbilical Hernia

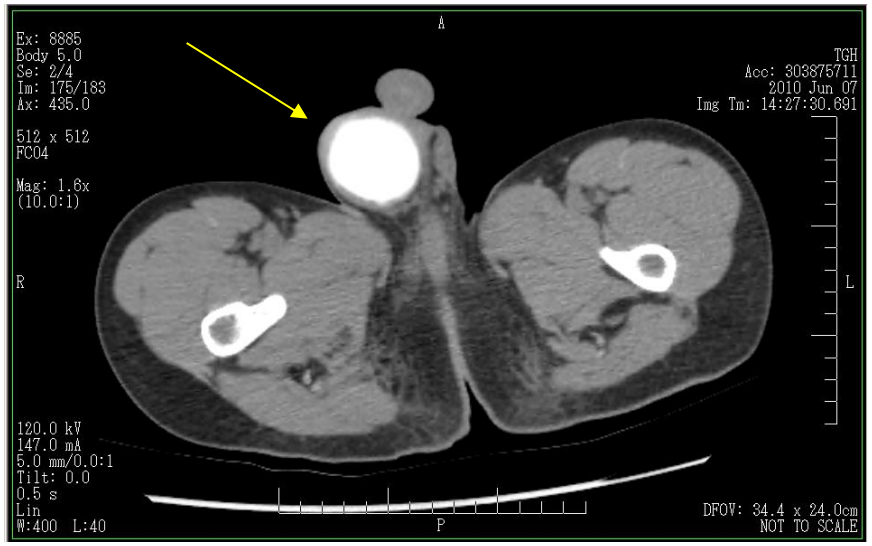
# Subcutaneous Edema Secondary to Dialysate Leak

# Abdominal Wall and Genital Edema

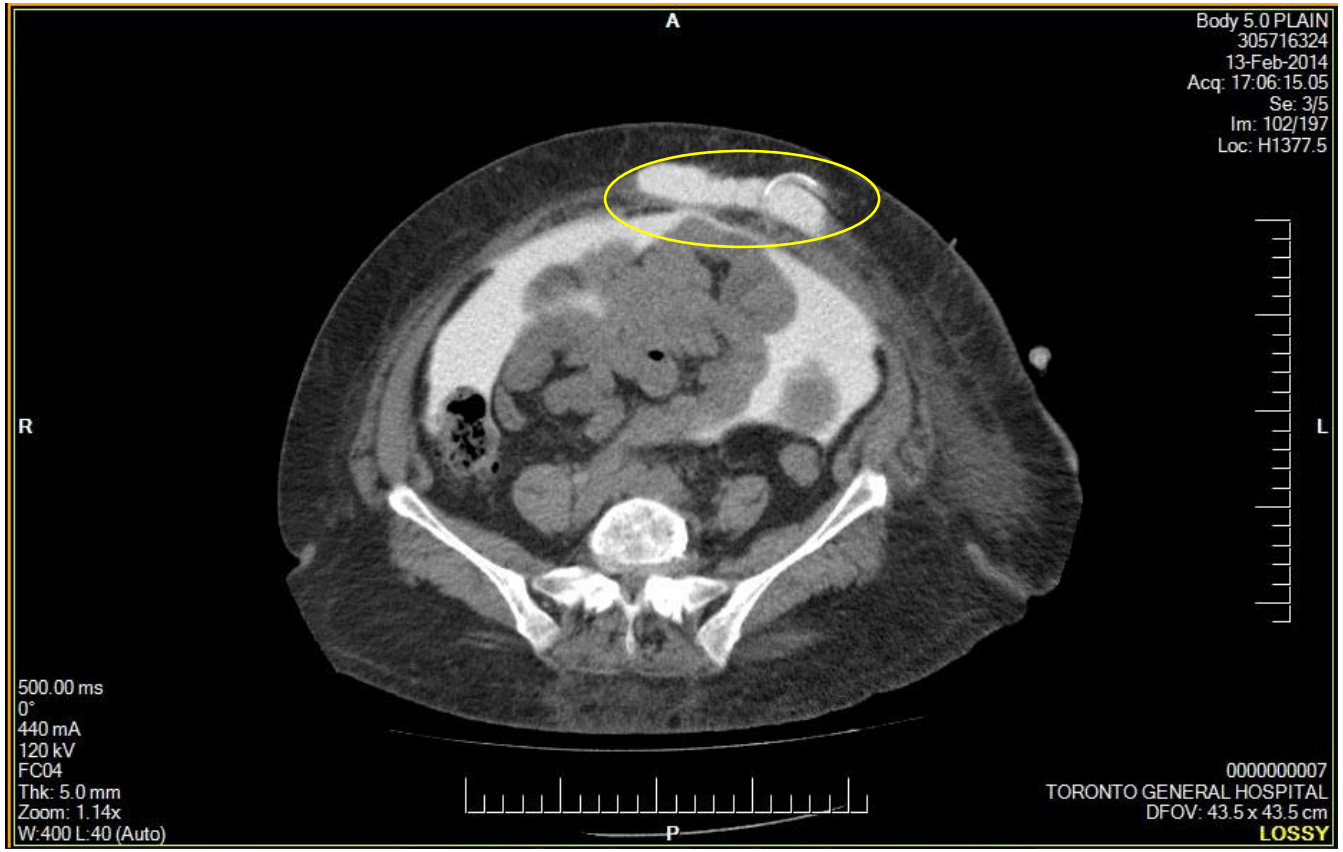
Diagnosis by CT Scanning:

- add 100-150 ml iohexol to dialysis bag
- infuse dialysate into patient
- have patient ambulatory for 30 to 60 minutes to increase intra-abdominal pressure
- send for CT scan - discuss with the radiologist

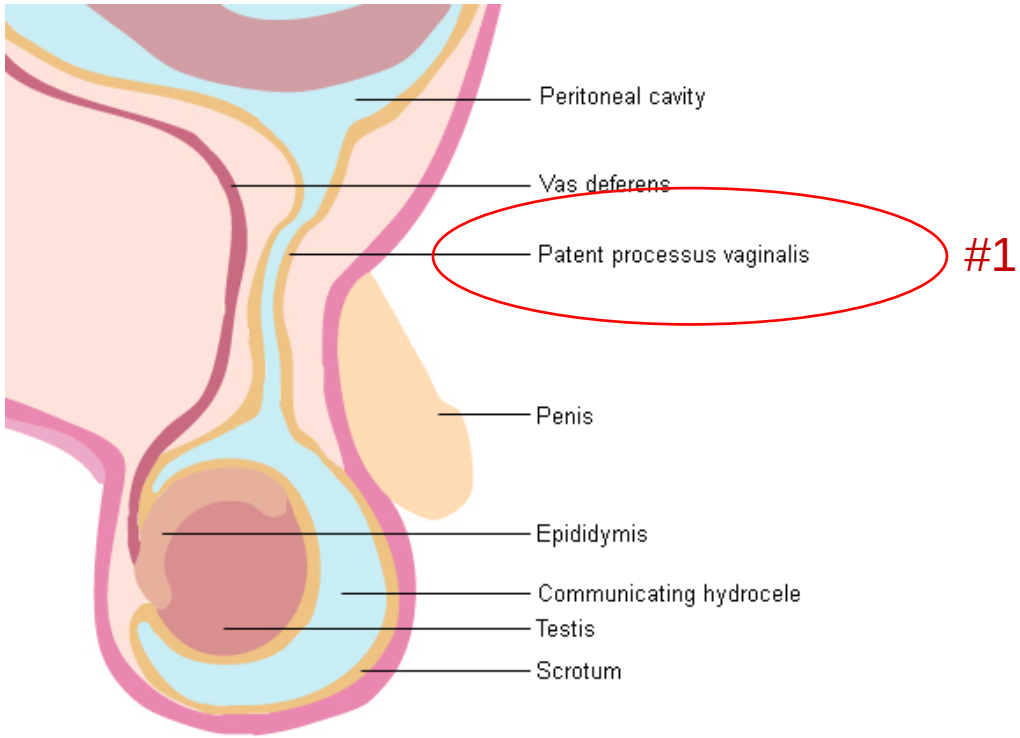
# CT Scan with IP Contrast in a Young Man With Scrotal Edema

# Leak of Dialysate Out of the Peritoneal Cavity



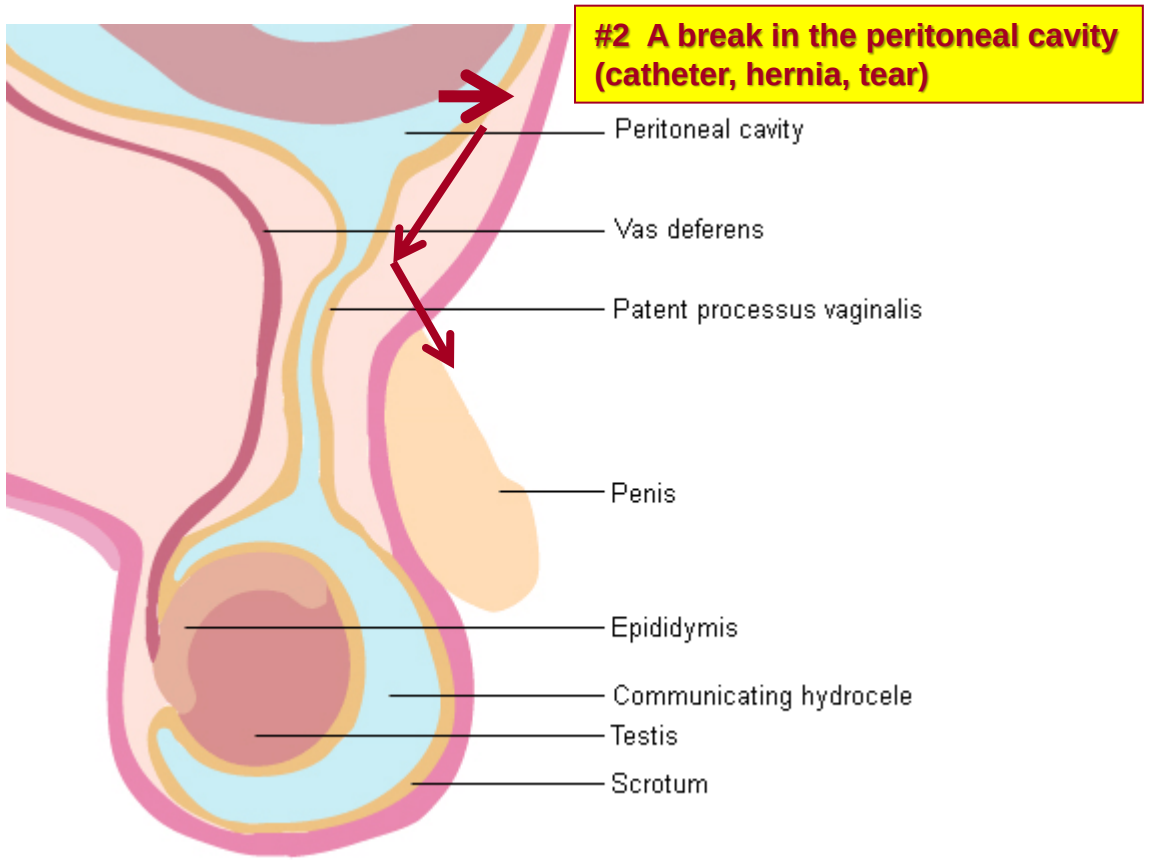
# Two Pathways to Genital Edema




#1

Leads to dialysate hydrocele +/- scrotal wall edema
Can lead to associated indirect inguinal hernia
Can uncommonly cause labial swelling in women

# Two Pathways to Genital Edema




Leads to abdominal wall edema
If tracks by gravity, edema of the penis or mons pubis

# Abdominal Wall & Genital Edema

## Management:

- reintroduce low pressure PD (eg APD with low volumes)
- temporary HD to allow healing
- abdominal wall: CT scan for occult hernia
- genital: CT scan for patent processus vaginalis, which is easily repaired

# SV and Her Scary Episode

- 28 year old woman, CKD of unknown etiology (presented with amenorrhea)
- predialysis education: chooses and starts on PD

# SV and Her Scary Episode

- doing well on PD
- menses resume
- with 2nd menses: painless bloody dialysate effluent
- to ER: hemodynamically stable, but urgent CBC, PTT, cross and type

# Hemoperitoneum

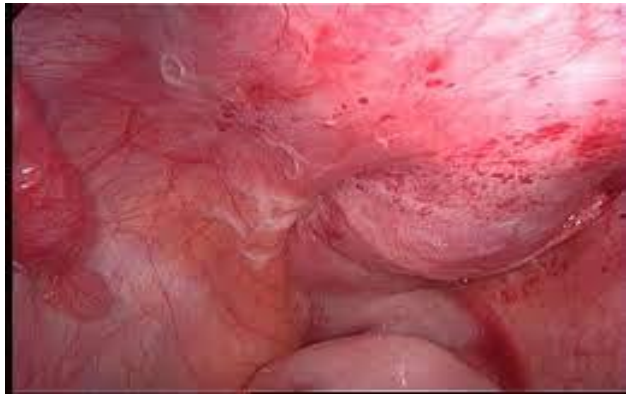
## “Benign” Causes

- menstruation (retrograde menses or endometriosis)
- ovulation
- ruptured renal or ovarian cysts
- trauma
- coagulopathy

# How Does Menstruation Lead to Bloody Effluent?

- retrograde uterine bleeding
- endometriosis of peritoneal cavity


speakendo.com



centerforendo.com

# Hemoperitoneum

## Serious Causes

- ischemic bowel
- hepatic or colon cancer
- pancreatitis
- encapsulating peritoneal sclerosis
- kidney cancer

# Hemoperitoneum

## Treatment

- IP heparin to avoid clotting of catheter
- flushes
- dialysate at room temperature if active bleeding
- investigations depend on whether benign or serious type of presentation

# And What Do You Think About This?

# So What Have We Learned? (1)

- constipation is the #1 cause of outflow obstruction in new catheters
  - having a bowel movement doesn't necessarily mean it's cured
- think of hydrothorax if a patient gets short of breath early in the course of PD

# So What Have We Learned? (2)

- long-term antibiotics are a risk for fungal peritonitis
  - fungal prophylaxis may or may not work, but it's low-risk therapy
- staph aureus or pseudomonas infection of BOTH exit site and PD fluid won't get better with antibiotics – remove the catheter

# So What Have We Learned? (3)

- commonest cause of hemoperitoneum is menstruation and needs no further investigation in that setting

# So What Have We Learned? (4)

## Hernias are common in PD patients

- try to prescribe day dry or small day volumes in at-risk patients
- they can usually be repaired operatively without switching to hemodialysis
- they may lead to secondary bowel incarceration and even strangulation
- they can be a source of leak of PD fluid into surrounding tissues

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