Intradialytic Complications during Hemodialysis

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Common Complications

- Hypotension
- Cramping
- Nausea and vomiting
- Headache
- Chest pain
- Itching

Less Common Complications

- Disequilibrium syndrome
- Dialyzer reactions
- Hemolysis
- Air embolism

Hypotension during hemodialysis

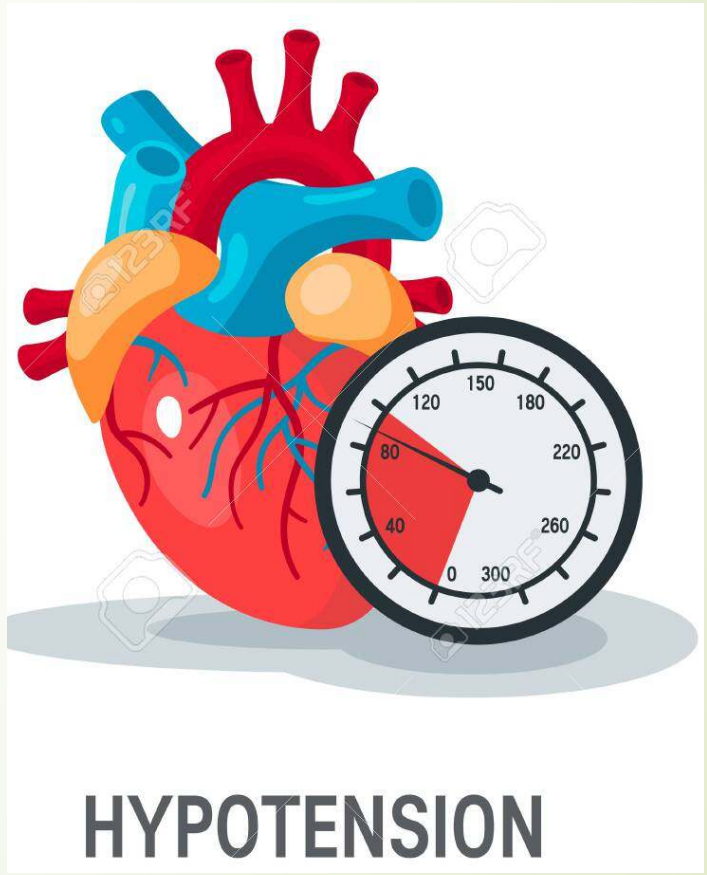
- Definition
  - Systolic blood pressure less than 90 mm Hg
  - A fall in systolic blood pressure of 20-30 mm Hg
  - A fall in some percentage of the starting blood pressure

Causes of Intradialytic Hypotension

- Blood volume changes
- Remember that blood pressure during hemodialysis normally does not decrease if fluid is not removed.
- Anything to help slow the ultrafiltration rate should reduce the incidence of intradialytic hypotension.
  - reducing the amount of volume ingested
  - increasing urine excretion
  - extending treatment time

Hypotension during hemodialysis

- Distressing symptoms
  - Dizziness, nausea, vomiting
- Associated with poor long-term outcomes
  - increased rate of myocardial stunning.



Hypotension during hemodialysis

- Avoid large weight gains between treatments
  - Emphasize fluid restriction between treatments
    - Difficult for patients
    - Offer alternatives to drinking fluids
  - Emphasize salt restriction-more effective than fluid restriction
    - Label reading
    - What should the restriction be?

Hypotension during hemodialysis

- Increase weekly treatment time
  - Will decrease required ultrafiltration rate-same weight removal in a longer time frame
  - In theory should decrease the frequency of hypotension
  - Kids that have problems with fluid management over the weekend and are symptomatic should have 4 days a week dialysis.

Hypotension during hemodialysis

- Residual urinary volume
  - Helps with fluid management
  - Add diuretic therapy
  - Measure urine output

Hypotension during hemodialysis

- Target weight or “dry weight”
  - Determined by:
    - Blood pressure, presence of edema, tolerance of ultrafiltration
    - Use of bioimpedance device

Hypotension Related to Lack of Vasoconstriction

- Reduced peripheral vascular resistance
- Reduced cardiac filling

Prevention of Vasoconstriction

- Lower dialysis solution temperature
  - Widely used dialysis solution temperature: 37° C
    - Better choice: 35.5°-36° C
    - Individualized per patient
    - Helps with shorter post dialysis recovery time
    - Improved blood pressure
    - Reduced myocardial stunning

Prevention of Vasoconstriction

- Eating during HD can precipitate or accentuate a fall in blood pressure
  - "Food Effect" lasts at least two hours
  - Patients prone to hypotension during dialysis should not eat just before or during dialysis

Prevention of Vasoconstriction

- Avoid administration of antihypertensive medication prior to dialysis
  - Helps with hypotension during dialysis
  - Helps cardiovascular system with fluid removal

Management of Hypotension

- Place patient in Trendelenburg position
- Saline bolus: 100 mL or more
- Decrease ultrafiltration rate
  - May be increased once patient is stable
- Review sodium restriction
- Reevaluate target weight
- Extend dialysis time

Muscle cramps during Hemodialysis

- Most common during first month of dialysis
- Causes
  - Hypotension
  - Hypovolemia
  - High ultrafiltration rate
  - Low sodium dialysis solution

Management of muscle cramps during hemodialysis

- Saline bolus
- Forced stretching of the muscle involved
- Massaging of muscle
- Heat

Prevention of muscle cramps during hemodialysis

- Stretching exercises
- Avoid low calcium and potassium dialysate
- Management of fluid between treatments

Nausea and Vomiting during hemodialysis

- Most episodes related to hypotension
- May be related to disequilibrium syndrome
- May be related to dialyzer reaction

- Management
  - Treat hypotension
  - Administer antiemetics

- Prevention
  - Avoid hypotension
  - Manage target weight

Headaches during hemodialysis

- Causes are unknown
  - However, caffeine withdrawal may cause
- Management
  - Give acetaminophen
- Prevention
  - Pretreatment acetaminophen

Itching during hemodialysis

- Very common
  - Hypersensitivity to dialyzer or blood circuit
- Prolonged sitting may make itching more noticeable
- Moisturizing and lubrication of the skin may help reduce itching
- Make sure dialysis is adequate: Kt/V > 1.2
- Reduce phosphorus, calcium, and PTH

Hypertension during hemodialysis

- Occurs in 15% of patients
- Associated with higher death risk
- Management
  - Lowering target weight sometimes works
- Prevention
  - Frequent monitoring of target weight and blood pressure

Disequilibrium Syndrome during hemodialysis

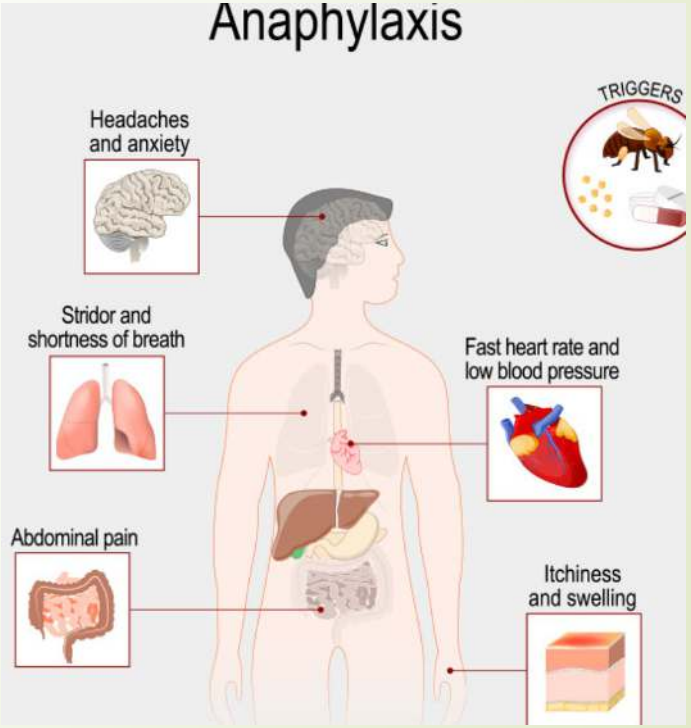
- Early manifestations include nausea, vomiting, restlessness, and headache
- More serious manifestations include seizure and coma
- A rare cause may be an increase in brain water content or from too aggressive dialysis

- Management
  - Reduce blood flow rate
  - May need to terminate dialysis early, if severe stop dialysis

- Prevention
  - Avoid overly aggressive treatment sessions
  - Avoid low sodium dialysis solution

Dialyzer reaction during hemodialysis

- Two types: Anaphylactic Type (Type A) or Nonspecific Type (Type B)
- Type A
  - Dyspnea, sense of impending doom, and feeling of warmth throughout the body
  - Itching, hives, cough, sneezing, and watery eyes
  - Dialyzer reuse reaction
  - Heparin
- Management
  - Stop dialysis immediately
  - Clamp any blood lines, do not return blood
- Prevention
  - Proper rinsing of dialyzer before use
  - Predialysis administration of antihistamine

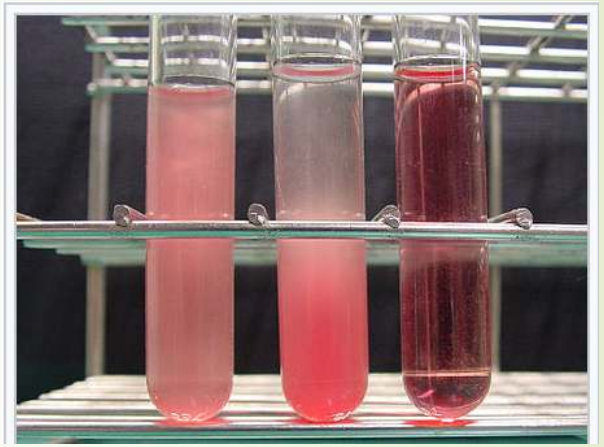


Dialyzer reaction of hemodialysis

- Nonspecific Type (Type B)
  - Chest or back pain
  - Cause is unknown
- Management
  - Supportive oxygen
  - Continue dialysis as symptoms typically disappear after one hour
- Prevention
  - Use a different dialyzer

Hemolysis during hemodialysis

- Medical emergency
- Symptoms
  - Back pain, tightness in chest, and shortness of breath
  - Port wine color of blood in the venous line
  - Marked decrease in hematocrit
- Causes
  - Blood line obstruction or narrowing
  - Overheated dialysis solution or dialysis solution contaminated with bleach or chloramine
- Management
  - Stop dialysis and clamp blood lines, do not return blood
- Prevention
  - Samples of dialysis solution should be tested
  - Check for kinked blood path or faulty roller pump



Air embolism during hemodialysis

- Symptoms/Signs
  - Foam in the venous blood line of the dialyzer
  - Seated patients
  - Loss of consciousness or seizures
  - Dyspnea, cough, and chest tightness
- Causes
  - Air entry: arterial needle, prepump arterial tubing, and inadvertently opened end of a CVC
- Management
  - Stop the blood pump and clamp the venous blood line
  - Place patient in lying position on the left side with chest and head facing down
- Prevention
  - Prevention of air into the system
  - Make sure air clamp alarm is on

Central Venous Line (CVL) during hemodialysis

- Most used vascular access in Pediatrics
- CVL dysfunction
  - Reduced blood flow
  - Reversal of lines
  - Frequent alarms
- Management
  - Ensure line is working
- Prevention
  - Cap with TPA
  - Proper size

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Complications in Peritoneal Dialysis

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Types of Complications in PD

There are two common types of complications in peritoneal dialysis

- **Infectious Complications**
- **Non-infectious Complications**

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Infectious Complications

Peritonitis

An infection in the peritoneal membrane caused by bacteria entering the peritoneal cavity.

Symptoms: fever, cloudy effluent, abdominal pain, irritability

Diagnosis: Positive culture and/or WBC >100 mm^3 with at least 50% Neutrophils

Treatment: Intraperitoneal antibiotics

Exit site infection

An infection at the site where the PD catheter exits the subcutaneous tissue

Symptoms: pain at exit site, drainage, redness or swelling

Diagnosis: Exit site score of 2 or greater with a positive drainage culture and 4 or greater regardless of culture results

Treatment: Oral antibiotics

Tunnel infection

An infection over the subcutaneous portion of the peritoneal cavity. Can be the result of an untreated exit site infection

Symptoms: pain/redness/swelling over the track of the PD catheter, pus or drainage at exit site

Treatment: Oral/IV/Intraperitoneal antibiotics

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Exit Site Scoring

TABLE 1
Exit-Site Scoring System

Parameter	Score[a] 0	1	2
Swelling	No	Exit only (<0.5 cm)	>0.5 cm or tunnel or both
Crust	No	<0.5 cm	>0.5 cm
Redness	No	<0.5 cm	>0.5 cm
Pain	No	Slight	Severe
Drainage	No	Serous	Purulent

[a] Infection should be assumed with a score of 4 or higher. Purulent drainage, even by itself, is sufficient to indicate infection. A score of less than 4 may or may not represent infection.

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Monthly Patient Education

- **The best way to decrease chance of infectious complications in PD is patient education**
- **Frequently educate patients and families about important topics**
  - Handwashing
  - Accidental disconnection
  - Contamination
  - Hole or leak in catheter or transfer set
  - Home environment (cleanliness, pets, etc.)

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Case Study

- **13 y/o female that just restarted PD after a failed transplant**
- **Initial PD training completed with mom and aunt**
- **Initial home visit by RN and social worker**
- **Patient arrived to ED later in the day with severe abdominal pain**
- **PD culture obtained**
  - >14,000 Leukocytes
  - 74% Neutrophils
  - Positive for Pasteurella
- **What do you think we observed during home visit earlier in the day?**

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Pasteurella

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Non-Infectious Complications of PD

- **Fibrin**
- **Hemoperitoneum**
- **Chyloperitoneum**
- **Obstruction**
- **Pain**
- **Extrusion of the external catheter cuff**
- **Fluid leaks**
- **Hernia**

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Fibrin

- **Fibrin in a protein that aids in the clotting of blood. It can be small flakes or large strands found in the effluent bag during peritoneal dialysis**
- **Can cause "no drain" or "slow drain" alarms if large enough**
- **Often occurs with presentation of peritonitis, new PD catheter, trauma to catheter, or menstruation**
- **Treatment: Heparinized Dianeal bags and frequent flushing. Can also attempt TPA with a 1-2 hour dwell**

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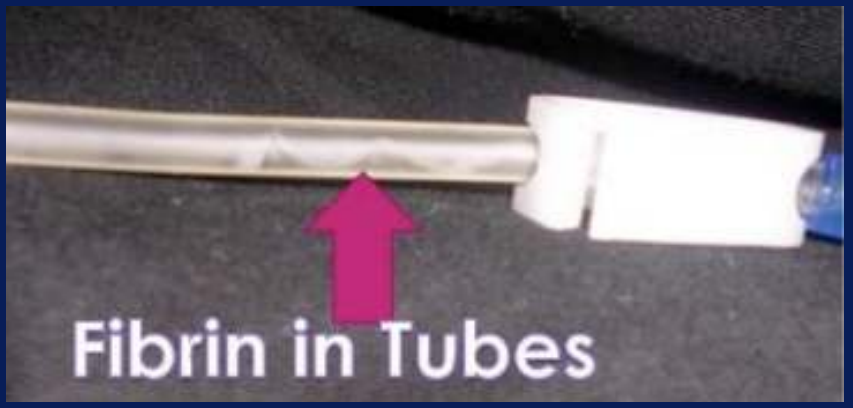
Fibrin



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Hemoperitoneum

- **PD effluent is pink tinged or bloody**
- **Common in menstruating females**
- **Could be caused by trauma to the PD catheter or a new PD catheter**
- **Typically will resolve in a few days without intervention**
- **Can flush the peritoneal membrane with heparinized dialysate to reduce the chances of clots forming**
- **About ½ teaspoon of blood will turn entire drain bag pink**

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Chyloperitoneum

- **Occurs when there is damage to the lymphatic system within the peritoneal membrane. Can be caused by insertion of PD catheter or trauma**
- **Results in accumulation of "milky" effluent with a triglyceride count >110-200 mg/dL**
- **Treatment: decrease fat in diet (change to short/med chain fat diet, or switch formula to Monogen if formula dependent) to decrease lymph leaking and allow for healing**

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Peritoneal Dialysis Fluid Appearance

Cloudy:

Bloody (hemoperitoneum):

Chylous:

Normal

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Obstruction

- **Several factors could cause this complication: wrapping of the omentum, catheter occlusion from blood or fibrin, kinked or migration of the PD catheter inside the peritoneal membrane, adhesions in the peritoneal membrane.**
- **Omentectomy at time of PD catheter placement**
- **Use of Heparin to dissolve clot or fibrin**
- **Sometimes surgical intervention is required to correct the position of the catheter or to remove adhesions**
- **Multiple episodes of peritonitis can cause adhesions making PD very difficult**

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Pain

- **Pain with fills**

  Can be caused by filling too fast, poor catheter position, fill volume too large, or dialysate not being warmed prior to filling

- **Pain with drains**

  Constipation is the number one reason patients experience drain pain

  Can also be caused by peritonitis, membrane irritation when empty, catheter position

  Important for all patients to have a bowel regimen to reduce chance of constipation.

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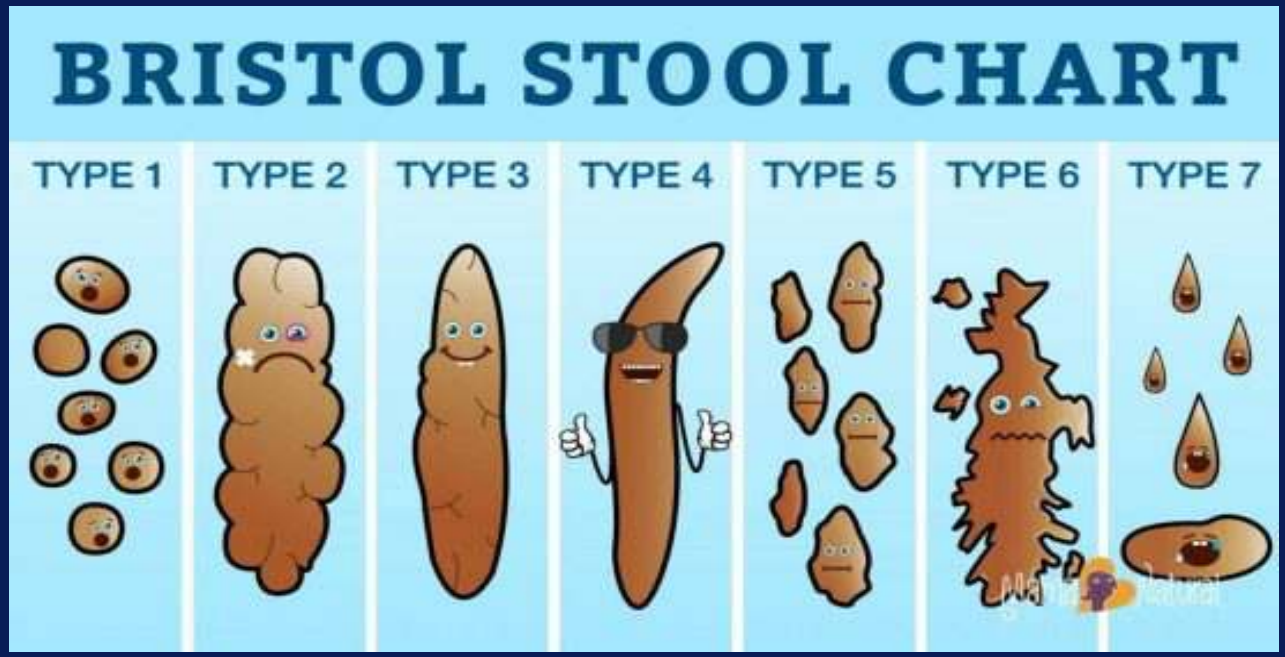

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Case Study

- **19 y/o female started home PD 1 day ago**
- **Contacted on-call dialysis nurse in the middle of the night to report "slow fill" and "low drain" alarms.**
- **Also reported pain with drains**
- **Drain bags clear**
- **Unable to report last BM**
- **Abdominal AP and Lateral x-ray ordered**

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Extrusion of the external catheter cuff

- **Sometimes the external cuff can erode through the subcutaneous tissue**
- **Can be painful**
- **Poor nutrition, multiple infections, and trauma to the PD catheter can contribute to this complication**
- **May require removal of PD catheter or cuff shaving**
- **May have to transition to HD for a period of time so tissue can heal prior to inserting a new PD catheter**

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Pictures of External Cuff Exposure

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Case Study

- **12 y/o patient transferred from OSH on PD. Cuff exposed at exit site upon arrival to our hospital. Catheter placed in another country, so no records to determine if one or two cuffs present.**
- **Exit site eroded, however no s/sx of exit site infection. Decided to not to remove catheter at this time since no infection present and PD working well. Exit site care daily.**
- **Several months later, admitted due to abdominal pain**
  - + Peritonitis
  - >8000 WBC's
  - + Pseudomonas
- **Treated with IP antibiotics. On day 4 of admission, noticed a fluid leak at the cuff site.**
- **PD Catheter removed and HD initiated**

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Fluid Leaks

- **Can be a result of how the PD catheter was placed, time between catheter placement when PD was initiated, and the abdominal wall characteristics**
- **Can occur inside the abdomen or around the exit site**
- **Typically, early leaks are external and late leaks are internal**

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Early Leaks

- **Fluid leaking from exit site is common when starting PD before the catheter is completely healed**
  - Results in decreasing fill volumes or holding PD altogether
  - Nutrition plays a part in healing
  - Ideally allow 2 weeks for catheter to heal before initiating PD
- **Low fill volumes (5-10 ml/kg) ideal if urgent start is required**
- **Decrease pressure to abdomen while catheter is healing**
  - No "tummy time" for infants
  - Only hold when patient is draining or empty

Keep catheter secured with anchor tape to minimize chance of trauma to exit site

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Late Leaks

- **Signs: poor drain flow/low UF, increase in weight, edema, subcutaneous fluid collection**
- **Many times radiological imaging is required to identify where the leak is occurring and if surgical intervention is an option**
  - Ultrasound
  - CT Peritoneogram with contrast
- **If surgery not an option**
  - Decrease fill volumes
  - Hold PD
  - Transition to HD

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Hernia

- Another type of late leak
- Very common in peritoneal dialysis patients due to the increased abdominal pressure from the dialysate fluid
- More common the younger the patient due to having a more fragile abdominal wall
- Typically causes a reduction in fill volumes
- Can cause pain with fills/dwells
- May need surgical intervention to repair
- After surgical repair, will have to slowly titrate to goal fill volumes, or continue at lower fill volumes to reduce the chance of recurrence
- May need to alter time/cycles to achieve the same results of therapy

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Late PD Leaks

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In Conclusion

- **Complications in peritoneal dialysis can be both infectious and non-infectious**
- **Infectious complications are treated with antibiotics. Non-infectious complications can be treated with surgical intervention, bowel management, diet modification, or adjusting PD therapy**
- **Early identification and management of PD complications results in better outcomes for the patient**

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There are two common types of complications in peritoneal dialysis

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- Non-infectious Complications

Infectious Complications

- Peritonitis
  - An infection in the peritoneal membrane. Caused by bacteria entering the peritoneal cavity.
  - Symptoms: fever, cloudy effluent, abdominal pain, irritability
  - Treatment: Intraperitoneal antibiotics
- Exit site infection
  - An infection at the site where the PD catheter exits the abdomen
  - Symptoms: pain at exit site, drainage, redness or swelling
  - Treatment: Oral antibiotics
- Tunnel infection
  - An infection over the subcutaneous portion of the peritoneal cavity. Can be the result of an untreated exit site infection
  - Symptoms: pain/redness/swelling over the track of the PD catheter, pus or drainage at exit site
  - Treatment: Oral/IV/Intraperitoneal antibiotics

Monthly Patient Education

- The best way to decrease chance of infectious complications in PD is patient education
- Frequently educate patients and families about important topics
  - Handwashing
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- Fibrin
- Hemoperitoneum
- Chyloperitoneum
- Obstruction
- Pain
- Extrusion of the external catheter cuff
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- Hernia

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- Fibrin in a protein that aids in the clotting of blood. It can be small flakes or large strands found in the effluent bag during peritoneal dialysis
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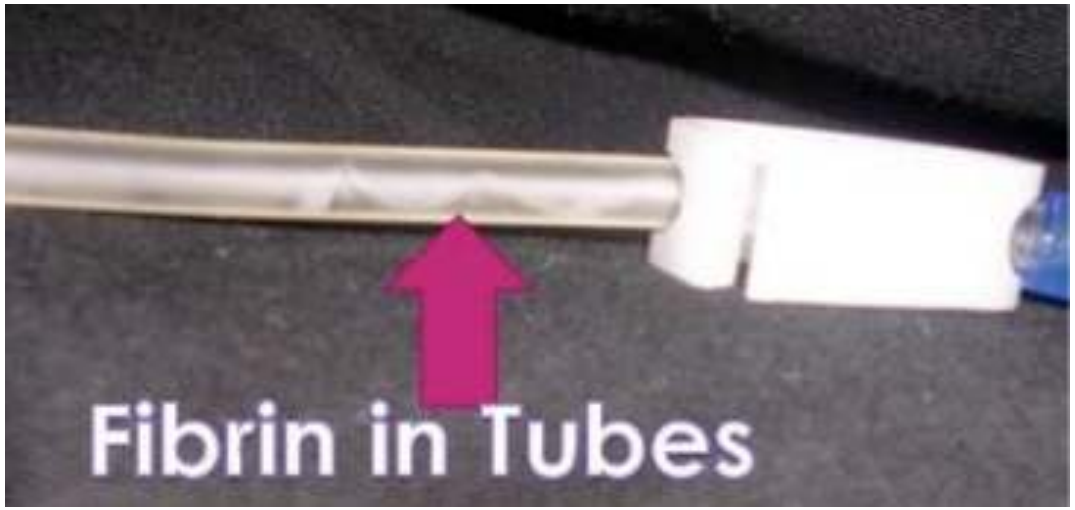

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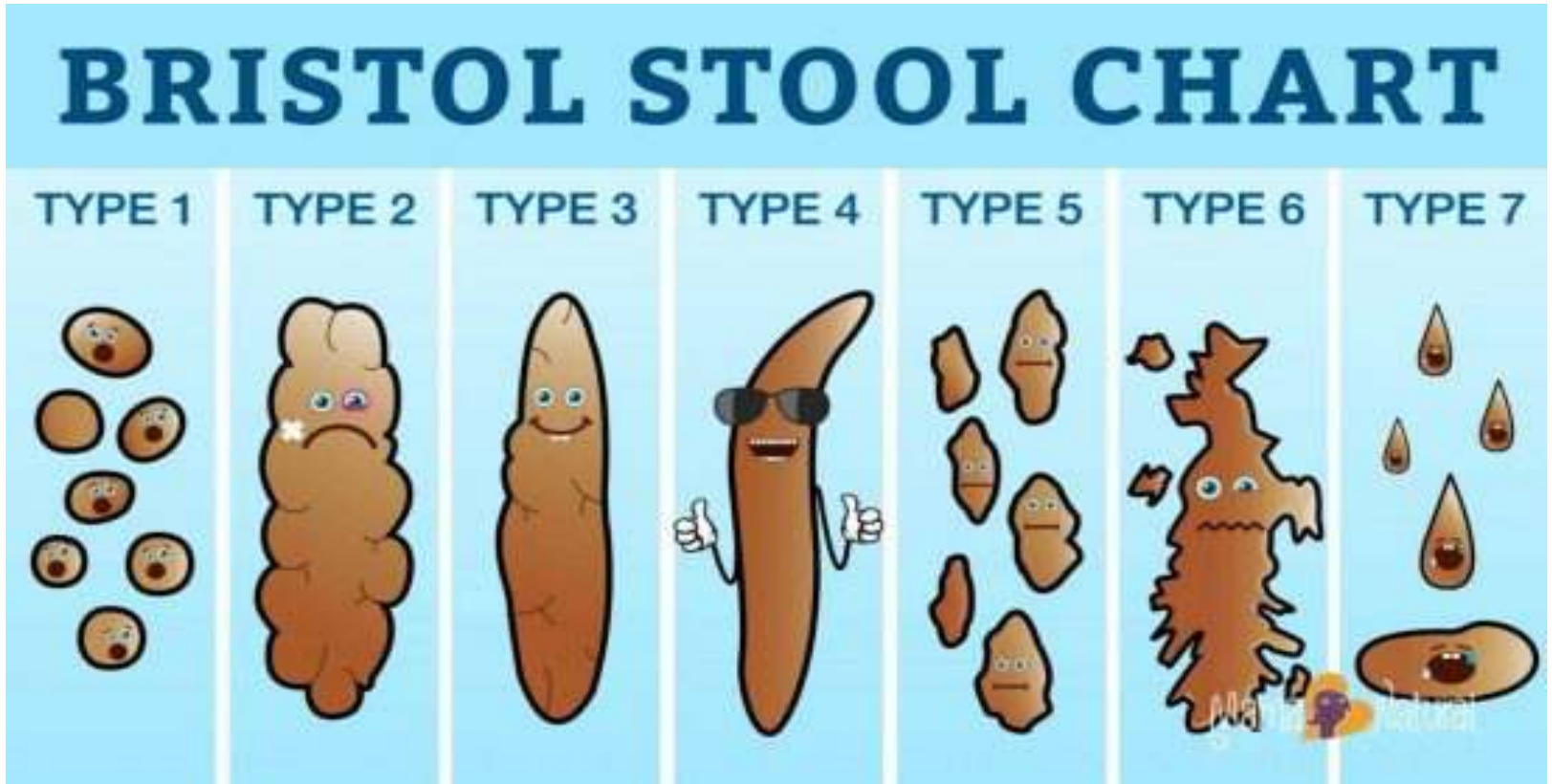
BRISTOL STOOL CHART
TYPE 1
TYPE 2
TYPE 3
TYPE 4
TYPE 5
TYPE 6
TYPE 7

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Late Leaks

- Signs: poor drain flow/low UF, increase in weight, edema, subcutaneous fluid collection
- Many times radiological imaging is required to identify where the leak is occurring and if surgical intervention is an option
  - Ultrasound
  - CT Peritoneogram with contrast
- If surgery not an option
  - Decrease fill volumes
  - Hold PD
  - Transition to HD

Hernia

- Another type of late leak
- Very common in peritoneal dialysis patients due to the increased abdominal pressure from the dialysate fluid
- More common the younger the patient due to having a more fragile abdominal wall
- Typically causes a reduction in fill volumes
- Can cause pain with fills/dwells
- May need surgical intervention to repair
- After surgical repair, will have to slowly titrate to goal fill volumes, or continue at lower fill volumes to reduce the chance of re-occurance
- May need to alter time/cycles to achieve the same results of therapy

Late PD Leaks

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