

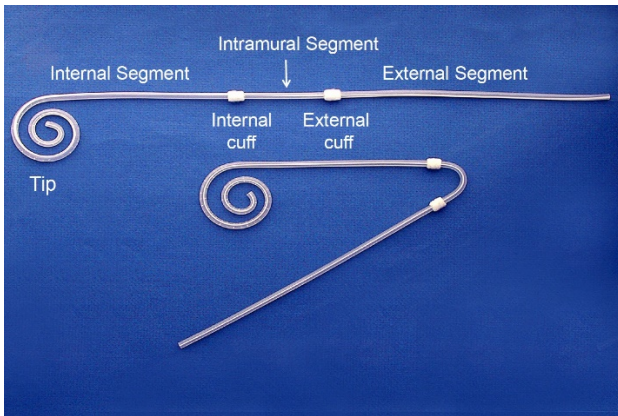
# Peritoneal dialysis

Department of nephrology/internal medicine

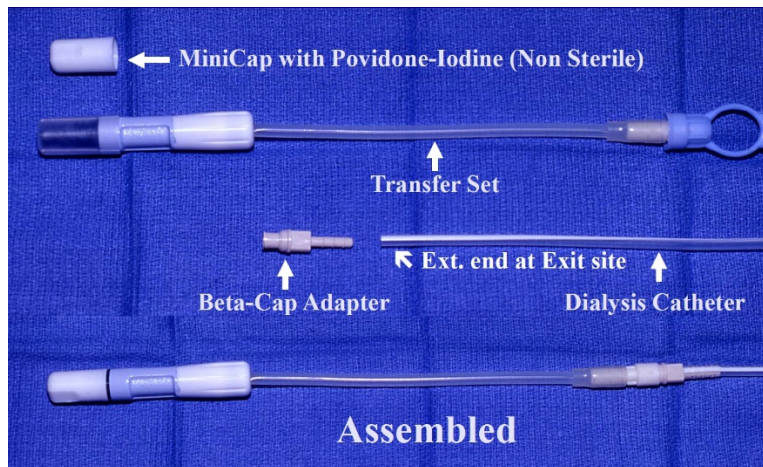
Stony Brook Medicine

## A. Components of peritoneal dialysis:

- Dialysis membrane ( peritoneum)
- Dialysate ( 1.5% yellow, 2.5% green, 4.25% red, 7.5% icodextran purple)
- Dialysis access
- Delivery system: connections and machine



## Transfer set assembly

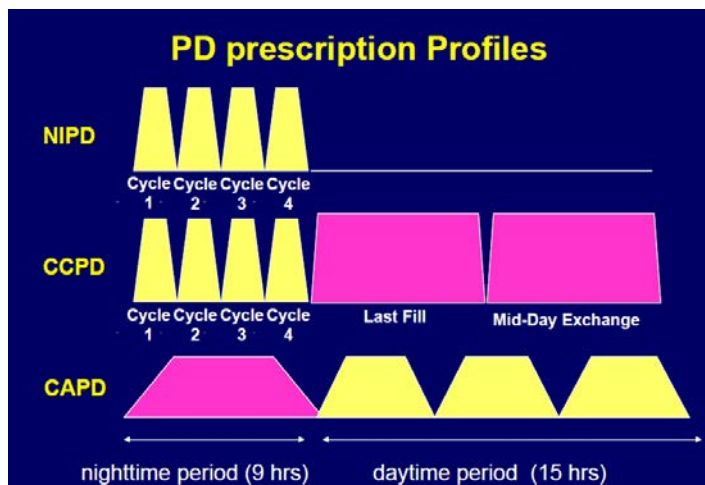


## B. Modalities:

1. Continuous ambulatory peritoneal dialysis (CAPD): continuous manual exchanges during day and night.
2. Automated peritoneal dialysis (APD): uses cycler machine.
  - Nocturnal intermittent PD (NIPD), exchanges through the cycler during night and the abdomen is empty during the day, used if good residual renal function.
  - Continuous cyclic PD (CCPD): cycler is used during night plus day time exchanges (last fill and day time exchanges).

Other less used modalities:

- Tidal PD: when proportion of the dwell is left in the abdomen in each exchange (usually less than 50%). Used to decrease pain and discomfort associated with draining.



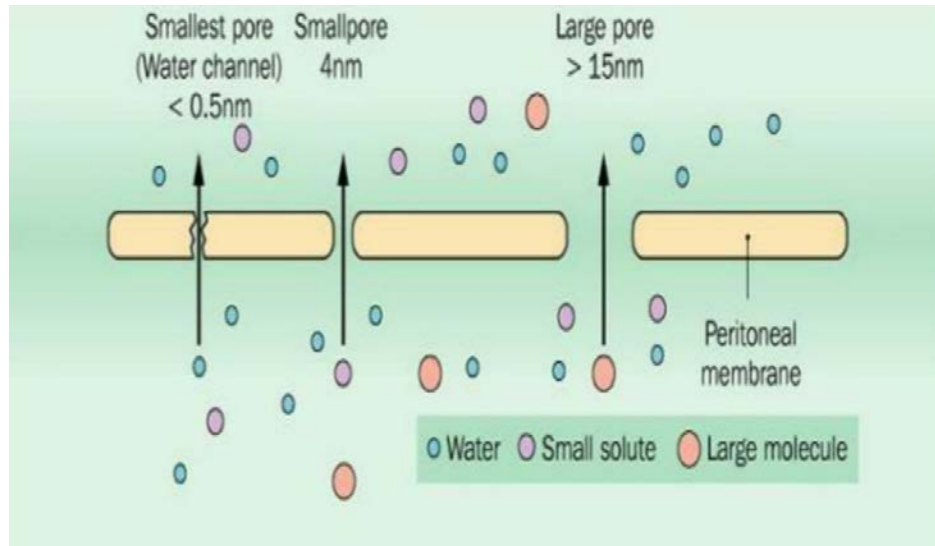
## C. Contraindications to PD

1. Absolute: homeless patient, encapsulating peritoneal sclerosis, peritoneal adhesions.
2. Relative: psychosis, hemiplegia, handicap, blindness, colostomy, nephrostomy, gastrostomy, poor motivation.

#### D. Peritoneal membrane character

Transcellular water transport and sodium sieving

The three types of pores:



#### E. PD prescription:

According to body surface area and membrane character:

Typical PD Regimens Required to Achieve Adequate Solute Clearances				
Peritoneal Solute Transport Characteristics-D/P Creatinine at 4 Hours				
Patient Body Surface Area (m <sup>2</sup> )	Low (<0.5)	Low Average (0.5 to <0.65)	High Average (0.65-0.82)	High (>0.83)
<1.7	CAPD/APD 10-12.5 liters	CAPD/APD+ 10-12.5 liters	APD+* 10-12.5 liters	APD* 10-12.5 liters
1.7-2.0	CAPD+/APD 12.5-15 liters	APD+ 12.5-15 liters	APD+* 12.5-15 liters	APD+* 12.5-15 liters
>2.0	CAPD+,HD	APD+ 15-20 liters	APD+* 15-20 liters	APD+* 15-20 liters

Adapted From Comprehensive Clinical Nephrology- John Feehally, Jurgen Floege, Richard J. Johnson, 3<sup>rd</sup> edition, 2007.  
+ an additional exchange , \* use of icodextrin solution .

The goal for KT/V is 1.7 per week.

#### F. Interventions for rapid transporters:

- Use NIPD with short Dwell time: 1-2 hours
- CAPD with rapid exchanges
- Use hypertonic fluid
- Use icodextran for long Dwell

#### G. PD adequacy:

- Solute clearance: add renal solute clearance if UOP >100 cc. check KT/V in 1-2 weeks after PD initiation or after prescription modification. In stable patients check KT/V every 3-4 months.

Measure solute clearance as below:

Total weekly KT/V =  $\frac{\{[(\text{dialysate volume for 24 hour} \times \text{dialysate urea}) + (\text{urine volume in 24 hour} \times \text{urine urea})]\}}{\text{BUN}} \times 7 / \text{TBW}$ .

Or if residual clearance given

$KT/V = (\text{dialysate urea/plasma urea}) \times (\text{total UF} / \text{TBW}) \times 7 + \text{residual renal clearance}$

Goal for total KT/V for PD + RRF is > or equal to 1.7.

Measure adequacy of dialysis by assessing volume status, protein level, and nutrition status. If patient is not thriving may increase dialysis dose and assess response.

Residual renal function is important predictor of outcome.

## H. Complications of peritoneal dialysis:

1. Peritonitis: <0.5% per pt per year.

### **Routs of peritoneal infection:**

1. Transluminal ( touch) 35%-50%
2. Periluminal ( exit site, tunnel) 15-25%
3. Intra abdominal 20% ( colonoscopy, constipation, diarrhea, enema, bowel perforation)
4. Hematogenous 5%, sepsis can cause peritonitis, peritonitis rarely causes sepsis.
5. Female pelvis, 1-2%

### **Diagnosis criteria: 2 out of the 3,**

1. Symptoms (abdominal pain, fever, cloudy fluid)
  2. Cloudy effluent with WBC>100, >50% polymorph after 2 hours dwell
  3. Positive culture
- Eosinophilic hyper cellularity is common during the first few weeks after dialysis initiation. May be misdiagnosed as peritonitis.
  - Microorganisms: 45% GPCs, 25% GNR, 20% culture negative.

### **Other DDx of cloudy effluent:**

1. Fibrin
2. Eosinophilic peritonitis
3. Chylous ascites
4. Hemoperitoneum
5. Malignancy

### **Prophylaxis:**

- a. Dental procedure, amoxicillin prior to procedure
- b. Colonoscopy: empty abdomen, antibiotics prior
- c. Gyn procedures like hysterectomy and IUD insertion.

- d. At the time of break in technique.
- e. When antibiotics used for >3 weeks consider adding antifungal, start fluconazole 100 mg daily.

- **Treatment:**

Empiric, cover G-ve and G+ve :

1. G+ve --1<sup>st</sup> generation cephalosporin ( cefazolin) or vancomycin
  2. G-ve – 3<sup>rd</sup> generation cephalosporin (ceftazidime or cefepime) or gentamycin.
- 
- a. Treat for 2 weeks for coagulase negative staph and 3 weeks for the rest, unless otherwise indicated.
  - b. Treat as outpatient if non septic.
  - c. Intra peritoneal antibiotics preferred over the IV.
  - d. Minimize the use of aminoglycoside in patients with residual renal function.
  - e. Resend PD fluid analysis after 48 hours of starting treatment to assess response.
  - f. Add heparin 500 u/litter ( preferred) if no contra indications

- **Indications for catheter removal:**

- a. If no response to treatment within 5 days.
- b. Tunnel infection
- c. Relapsed peritonitis (same microorganism) within 4 weeks.
- d. Fungal or AFB peritonitis.

2. Exit site infection

- Findings/ diagnosis: erythema, drainage, pain at the catheter site.
- Prevention: daily use of gentamicin or mupirocin cream
- Treatment:
  - a. PO antibiotics, minimal of 2 weeks, can use dicloxicillin , Bactrim, or ciprofloxacin.
  - b. Local iodine or peroxide BID
  - c. If no response then needs catheter removal and placement in another location.

3. Catheter flow problem:

- a. Inflow problem: mechanical problem, fibrin clot. Try saline flash, once patent use heparin 500 u with each exchange. If saline did not help can use TPA for 2-4 hours. If no success then IR / surgery manipulation.
  - b. Outflow problem: constipation (most common), migration of the catheter, catheter entrapment.
  - c. Fluid leaks:
    - Abdominal wall leak or new hernia, diagnosed with CT with IP contrast, treatment is surgical.
    - Hydrothorax: diagnosed by checking pleural fluid glucose. It is usually more than serum glucose. Stop PD for 2 weeks if persist then requires pleurodesis.
4. Abdominal pain with draining or with inflow: use tidal mode, or bicarbonate containing dialysate.
  5. Blood stained PD fluid: DDX : infection, abdominal cancer, trauma or menses.

### **Ultrafiltration failure:**

Patients presented with edema, high blood pressure (signs of volume overload)

DDx of UF failure:

- a. Outflow obstruction due to catheter malposition or constipation. Check with X ray.
- b. Uncontrolled blood sugar.
- c. Catheter leak or hernia, rest membrane for 2 weeks.
- d. Increase lymphatic drainage
- e. Encapsulated peritoneal sclerosis, diagnosed with abdominal CT or laparotomy.

In case of d, e, treatment is to rest peritoneal membrane for 3 months.

Diagnosis of UF failure as by PET scan

**PET scan:** a test performed to characterize the transport of the peritoneal membrane.

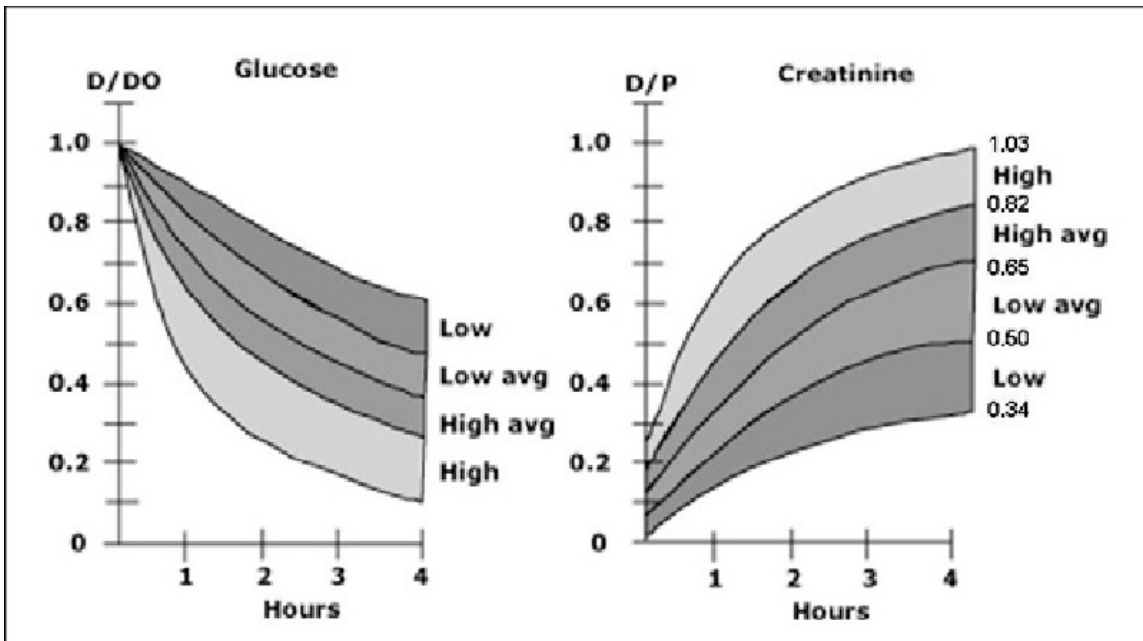
- Method:
  - a. Empty the abdomen
  - b. 2 liters of 2.5% fluid is infused.
  - c. Blood and dialysate are sampled at 120 min
  - d. Drainage at 240 min

- e. Dialysate to plasma creatinine and dialysate glucose at 240 min are used to calculate the transport characteristics.
- Permeability testing: hypertonic dialysate is infused; the dialysate sodium is measured after 1 hour. Drop in dialysate sodium predict the aquaporin function.
- Membrane failure testing: infusing hypertonic dialysate, 4 hours if UF<400 cc then diagnose UF failure.

High transporters tend to have problems achieving ultrafiltration goals but are efficient with clearance.

Low transporters tend to achieve ultrafiltration goals but have difficulty with clearance targets.

Traditionally, high transporters were thought to do best on regimens that involve frequent short duration dwells (APD) maximizing ultrafiltration, and low transporters needed longer dwell times.(CAPD) to maximize clearances.





## Recourses

<https://www.uptodate.com/contents/prescribing-peritoneal-dialysis>

[https://www.uptodate.com/contents/risk-factors-and-prevention-of-peritonitis-in-peritoneal-dialysis?search=prophylaxis%20for%20dental%20procedures%20in%20peritoneal%20dialysis&sectionRank=1&usage\\_type=default&anchor=H6&source=machineLearning&selectedTitle=1~150&display\\_rank=1#H6](https://www.uptodate.com/contents/risk-factors-and-prevention-of-peritonitis-in-peritoneal-dialysis?search=prophylaxis%20for%20dental%20procedures%20in%20peritoneal%20dialysis&sectionRank=1&usage_type=default&anchor=H6&source=machineLearning&selectedTitle=1~150&display_rank=1#H6)

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<https://www.slideserve.com/grace/peritoneal-dialysis>

[https://www.researchgate.net/figure/Traditional-curves-of-peritoneal-equilibration-and-classes-of-transporters-assessed-as\\_fig1\\_44665437](https://www.researchgate.net/figure/Traditional-curves-of-peritoneal-equilibration-and-classes-of-transporters-assessed-as_fig1_44665437)