

Supplemental Information for “Acute Peritoneal Dialysis During the COVID-19 Pandemic at Bellevue Hospital in New York City”

Guide for Acute Peritoneal Dialysis for Treatment of Renal Failure in COVID+ Patients

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Introduction:

The COVID-19 pandemic created an unprecedented strain on the U.S. health care system. Nowhere was this greater than in New York City, which became one of the global epicenters. The incidence of acute kidney injury (AKI) in severely ill hospitalized patients was about 40% at our institution.

Conventional hemodialysis (HD) and continuous renal replacement therapies (CRRT) are resource and labor intensive, exacerbated by a higher than usual frequency of clotting, due to a hypercoagulable state.

Severe AKI with COVID-19 requiring urgent dialysis and an increasing number of chronic HD patients who miss their regularly scheduled dialysis sessions are anticipated to present to the emergency department for possible admission. We anticipated we would not be able to handle the increased demand during the peak surge of patients during the outbreak and decided to start an acute peritoneal dialysis program at Bellevue Hospital (BH).

Overall Objectives:

Initiate acute peritoneal dialysis (PD) in select patients to:

- Maintain RRT capacity
- Maintain a manageable number of patients and workload for HD nursing and ICU staff performing continuous venovenous hemofiltration (CVVH).

Utilize PD which will allow for rapid training of additional medical staff without dialysis expertise.

A major advantage of PD is the ease with which nursing and other staff can be trained. The procedure is not technically challenging but requires strict sterile technique. The learning curve to train staff to provide HD, CVVH, and AVVH is much steeper.

PD allows for an expanded pool of trained staff which can include nurses, PAs, technicians, and physicians.

Another advantage of PD is that the timing of exchanges can be varied to permit other nursing activities to minimize additional exposure and use of PPE.

Surgeons at NYU, Bellevue, and the Manhattan VA with expertise in PD catheter placement have committed to providing support with the placement of double cuff peritoneal dialysis catheters.

Targeted patients for acute start inpatient PD:

- 1) AKI patients in acute care or ICU beds with indications to initiate RRT and who meet criteria for PD catheter placement (see below).
- 2) COVID Neg->Stage 5 chronic kidney disease in need of RRT will be considered for PD.
- 3) Patients who have initiated HD or CVVH during the current admission for AKI, who do not have a contraindication for PD and are expected to have a prolonged hospital stay.
- 4) If HD demands outpace capacity, admitted ESKD patients on HD may be transitioned to PD.
 - ESKD/HD patients who are utilizing many resources i.e. additional UF sessions
 - All admitted patients may be considered, regardless of COVID-19 status, or whether they will be able to do PD as an outpatient.
 - PD candidates can have both HD/PD access upon DC with plan to transition to PD as outpatient to minimize chronic HD usage

The proposed workflow:

- a) Inpatient renal teams to assess patients for criteria to initiate or transition to PD.
- b) Identify these patients to the PD team (TBD at each hospital)
- c) If approved by PD team, they will contact surgeon/interventional radiologist to insert the PD catheter – ideally within 24 hours of the request
- d) Initiate exchanges immediately post-catheter placement using low volume (500ml) for the first 24 hours as per protocol.
- e) if no peri-catheter leaks or other complications the volumes would gradually be increased to maximum 2000mL over 1-2 days.
- f) Adjust prescription to control fluid overload, hyperkalemia and acidosis rather than to target a specific Kt/V
- g) Exchanges will be performed when PD staff is available. Icodextrin can be used for overnight dwells if this is available to lessen the workload.

PD Candidates:

Patients will be considered suitable unless the following are present (exclusion criteria). •

- Known varices
- Prior lower abdominal surgery (relative contraindication)
- Known abdominal adhesions
- Hyperkalemia >6.5 mEq/L refractory to medical management or with evidence of cardiac instability/arrhythmia

COVID-19 Concerns:

Critically ill COVID-19 patients are frequently ventilated with high FiO₂ and PEEP settings.

Theoretically, PD can raise intraabdominal pressure (IAP) and cause difficulty ventilating if there is too much pressure on the diaphragm.

- Consider monitoring bladder pressure while the patients are paralyzed and intubated to ensure no excessive IAP rise. Target <10-12mmHg.

The use of prone positioning is common in COVID-19 patients to try to improve oxygenation and although a theoretical contraindication, PD could be considered on a case by case basis if needed.

PD Protocol:

- Once PD candidate identified, initiate laxative to ensure adequate bowel movement: recommend lactulose, senna, colace, miralax as viable options.

- Dressing changes should be minimized during COVID-19 but performed when visibly soiled or leaking. An order should be placed for the application of gentamycin cream 0.1% or mupirocin cream 2% (or other antibiotic cream) to catheter exit site with each dressing change.
- Vancomycin 1 gram IV should be given peri-operatively
- Access to be inserted at bedside. Double cuffed PD catheter to be used. The catheter kit contains a plastic connector that should be placed by the surgeon. The transfer set should be attached before the sterile field is broken. If the catheter is not being used immediately, after checking for proper placement and flushing, instill 6000u (6ml of 1000u/ml heparin) into the transfer set, then disconnect bags and tubing.
- Cover with a NEW cap. NEVER REUSE MINICAPS or STAY SAFE Caps
- Low volume PD should begin immediately after catheter placement, unless advised otherwise by surgeon.
- Once access is obtained (before sterile field is broken) catheter is to be flushed with 1.5 or 2.5% dextrose solution with Heparin 500U/L added (1000u total for a 2L bag). The flush volume infused is 500mL and immediately drained. We repeat this for the entire 2000mL bag: 4 infusions, 3 drainages. The final 500cc is left in the peritoneum for 2 hours and then drained and continue exchanges as per the protocol.
- If patient has severe hypertension or volume overload, call nephrologist for high dose oral/IV diuretic and 4.25% dialysate.
- About 48 hours after catheter insertion, titrate up to 2000mL dwells q2h-3h.
- Of note, as exchange frequency increases, the frequency of connections and disconnections will necessitate additional bedside contacts. If the extension line is obtainable (see below, Baxter only) it can be used to reduce direct patient contact

PD Nursing Instructions for PD during COVID:

- All PD assessments and exchanges can be rescheduled and timed with existing nursing activities if exchanges to be done by the nursing staff.
- Exchanges are to be performed in supine position unless the patient is to be placed in the prone position and then use the prone protocol.
- If patient has a cough, we recommend cough suppressant.

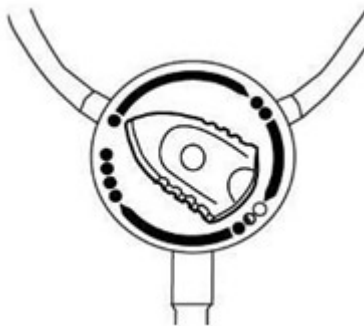
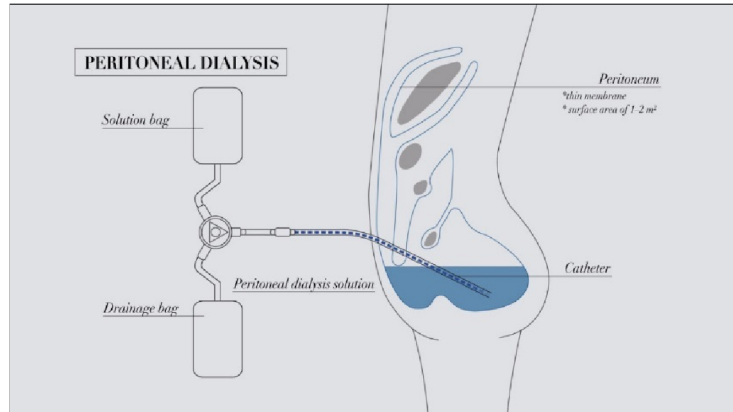
Manual Peritoneal Dialysis Protocol

Equipment needed

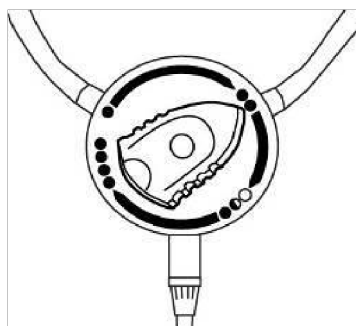
- Hanging scale
- Dialysate fluid bag-% as per nephrologist
- Clamp (or tape)
- Appropriate PPE (goggles/face shield, gown, mask, gloves)
- Heparin
- Sanitizing solution (Alcohol, Chlorhexidine, Iodine etc.)
- Iodine cap

Background

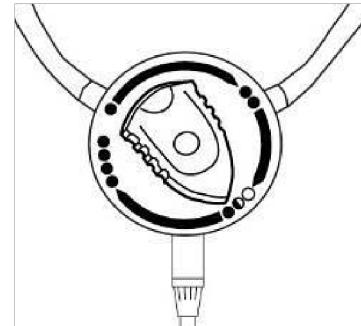
There are 3 settings for manual peritoneal dialysis using the Fresenius 'stay safe' organizer: Drain (position 1), Flush (position 2) and Fill (position 3). The dial on the stay-safe disc makes it easy to visualize which position you are in.



Position 1/ Drain



Position 2/ Flush



Position 3/ Fill

Procedure

1. Prep bag

- a. Open packaging
- b. Wash hands/don gloves
- c. Clean med port of the dialysate bag with sanitizing solution. Remove the heparin cap and sterilize the top. Sterilize the port on the PD fluid bag with sanitizing solution.
- d. Inject appropriate amount of Heparin into dialysate bag after sterilizing the med port with sterilizing solution (alcohol can be used)
(dose: 500 units of Heparin per 1 Liter of dialysate fluid)
- e. Remove cap from front of dial/bag
- f. Turn dial into drain position (if using Fresenius products)
- g. Break cone on bag

2. Stage area for peritoneal dialysis

- a. Don appropriate PPE
- b. Gather supplies needed (dialysate, scale, clamping device)
- c. Enter room 3. Initial prescription:
 - a. If newly placed catheter then flush with 1.5% (or available %) 500mL x3 with draining between flushes (can flush more if needed to clear up blood)
 - b. Start 500mL dwells with 2-3-hour dwell time for 3 dwells. (don't worry if some fluid gets resorbed the first 24 hours because this is expected)
 - c. If no leaking and tolerates can increase to 750mL x 1-2 dwells and then 1000mL for 2 dwells, then 1500mL for 2 dwells then 2000mL (full volume)
 - d. Start regular manual PD with prescription based on metabolic needs and staff availability to perform exchanges.

4. Initiate set up

- a. Hang scale on IV pole above patient
 - i. Make sure it is set at zero
- b. Hang dialysate fluid bag onto scale and affirm accurate weight
- c. Slowly peel drain bag from dialysate bag and place on the floor beside patient bed, taking care not to step on said bag
- d. ALWAYS MAKE SURE PATIENT'S CLAMP IS CLOSED PRIOR TO ATTACHMENT
- e. Aseptically attach patient line to patient connector on dialysis bag, taking care to keep both ports clean
- f. Set dial to position 2 and watch for approximately 2 seconds until you see bubbles created by fluid coming through flush line
- g. Immediately set dial to position 3 and unclamp patient line
- h. Watch scale to make sure appropriate volume is instilled for the dwell (If using <than the total contents can use the scale to determine the desired dwell volume.
- i. Once appropriate volume has instilled
 - i. Clamp patient line
 - ii. Clamp upper dialysate line (with clamp or tape)
 - iii. Set dial back to position 1
 - iv. Make note of the time, this is your dwell start time
 - v. Remove PPE and dispose of
 - vi. Document start time, prescription, and volume of dwell

5. Drain

- b. After dwell time is completed, Don PPE and prepare to re-enter room
- c. Open clamp on patient end of line
 - i. You will note the drain bag on the floor begin to fill with fluid (check for clarity).
 - ii. Allow 20 minutes for fluid to collect in drain bag
 - iii. Remove PPE and dispose properly
- d. After draining for approximately 20 minutes
 - i. Clamp patient line
 - ii. Note color of drained fluid
 - iii. Hang drain bag onto scale and assess the amount of fluid collected
 - iv. Record drain time, color of fluid, and volume output
- e. Aseptically initiate next dwell as before or apply Iodine cap and infuse heparin if additional dwell is not needed
- f. Clamp all lines before disposal to prevent leaks
- g. Dispose of peritoneal effluent as per hospital infection control protocols

Common PD issues:

Slow drain or fill of dialysate

- Attempt to reposition patient (sometimes a patient will drain better when leaning more to one side)
- Determine no pericatheter leak
- Gently press on patient's abdomen while trying to fill/drain
- Attempt to flush line with 50 mL sterile syringe of saline 1-3 times
- Ask nurse if patient has had bowel movement in the past 24 hours ○ Constipation can prevent adequate draining in PD patient. Implement increased bowel regimen as needed
- Check an Abdominal film for PD catheter placement, Constipation or other unanticipated complications
- Can try tPA for possible fibrin clot at this point as per protocol

Blood in the PD fluid

- Flush with 1.5% 500mLx3 or until the fluid clears, if does not clear consult surgery

Cloudy PD fluid

- Send the fluid for culture and cell count
- Start antibiotics prophylactically until the culture is available and then can customize treatment based on organism and sensitivities

PD catheter leak

- Check the integrity of the catheter for damage
- Decrease the dwell volume to 500mL and proceed with manual exchanges. If no acute metabolic needs can hold PD exchanges for 12-24 hours and then resume PD starting at low volume. If holding PD temporarily, place heparin 6000u/6mL in the transfer set as per protocol. Cap to close the transfer set.
- Place a new dressing as per the protocol

tPA Protocol

- instill 8cc of 1mg/cc (8mg total) into the transfer set/PD catheter (total volume of the catheter and transfer set usually 6-7cc)
- let dwell in the catheter for 60 min
- try to flush with 50cc NS. If good flow can attempt a regular infusion and dwell. If still not good flow can repeat X1.
- If still poor flow consult surgery

ADDING MEDICATION TO THE PD FLUID

- When adding anything soak the med port of the solution bag for 3 min with alcavis or other sterilizing fluid (alcohol can be used)
- When adding any medication soak the top of the bottle with sterilizing solution for 3 min and always change the needle and always use a clean needle before adding the heparin (or other medication) to the fluid

Record Keeping:

Document:

- Time of the exchange,
- Fill volume,
- Drain volume (can be weighed with the scale or estimated), and
- Effluent appearance (cloudy, clear)
- Exit site

Solution Strength:

Peritoneal dialysis solution comes in three strengths, which are color coded:

- A) **Yellow** or 1.5%--This solution has a low glucose concentration and will lead to little or no ultrafiltration (fluid removal). The effluent drain volume may in fact be smaller than the fill volume
- B) **Green** or 2.5%--This solution contains a medium concentration of glucose and in most patients will lead to ultrafiltration (fluid removal).
- C) **Red** or 4.25%--This solution will lead to the greatest amount of ultrafiltration (fluid removal). D) Icodextran--Used for overnight dwells (8-16 hours) (Baxter only)



The nephrologist will change the solution strength depending upon the patient's hemodynamic status and fluid volume status.

Exit Site Care

- Clean exit site with normal saline. Tegaderm over exit site
- Administration of gentamycin cream 0.1% or mupirocin cream 2% to the exit site whenever the dressing is changed
- Avoid ointments as these may break down the polyurethane in the catheters.



Fresenius Stay Safe 1.5% Dextrose solution with tubing and drain bag



Fresenius transfer sets



Stay safe caps (Fresenius)



Baxter 2.5% dextrose solution bag with drain bag attached



Beta adaptor

Baxter Transfer Set



Baxter minicap

PD CATHETER PLACEMENT

Bedside technique description: From PD Surgeon Dr. Cheguevara Afaneh; other surgeons can use it potentially and it obviates the need for fluoroscopy

1. A right upper quadrant incision is made 3 cm lateral to the midline.
2. The subcutaneous tissue is dissected away from the anterior rectus sheath using monopolar energy and retractors.

3. Once the anterior rectus sheath is clearly exposed and clear of any subcutaneous tissue, it is sharply incised.
4. The muscle is then bluntly dissected away until the posterior rectus sheath is identified.
5. Two tonsil clamps are used to pull the posterior rectus sheath superiorly and away from the bowel. To avoid inadvertently grabbing the bowel, clamp the posterior rectus sheath on each side, then unclamp each clamp sequentially and re-clamping.
6. Sharply incise the posterior rectus sheath. A window into the peritoneal cavity is now achieved.
7. Advanced the dilator/sheath under direct visualization while pulling up on the clamps to create a potential space into the peritoneum. A 2-0 vicryl U-stitch is placed but not tied around the dilator/sheath.
8. Next, the dilator is withdrawn, and the sheath remains in place.
9. A 62.5 cm swan neck curl right-sided peritoneal dialysis catheter is introduced through the sheath after soaking it in heparinized saline and expelling all the air from the cuffs.
10. The sheath is snapped and withdrawn as the dialysis catheter is introduced. Care is taken to ensure the anterior line remained in the orientation as the catheter is advanced into the peritoneal cavity.
11. Once the sheath is fully withdrawn, the distal cuff is advanced into the rectus muscle.
12. The cuff is then secured to the posterior fascia by tying the 2-0 vicryl U stitch. This creates a tight seal and allows for initiation of emergent PD.
13. The anterior fascia is closed with 2-0 vicryl suture, taking care not to kink the tubing, allowing a window for the catheter to exit the anterior sheath. The catheter should be flushed at various points to ensure there is no kinking of the tubing with heparinized saline both before and after the catheter is tunneled.

Tunneling the cuff

1. The catheter dimensions and exit sites are measured.
 2. A <1 cm exit site is made approximately 3-4 cm inferior and lateral to the introducer site.
 3. The proximal end of the catheter is attached to the tunneler.
 4. A subcutaneous tunnel is fashioned, and the catheter withdrawn through the exit site.
 5. The tubing is separated from the tunneler. The cuff should clearly be 1-2 cm proximal to the exit site.
 6. The connector is attached to the end of the PD catheter (usually included in the catheter set)
 7. The transfer set (usually either Fresenius or Baxter) is attached before the sterile field is broken, and catheter should be flushed to assure flow because kinking under the skin can happen when it is tunneled.
 8. ap if not being used immediately.
 9. The introducer site is closed with deep dermal sutures with 3-0 vicryl. The skin is closed with 4-0 suture.
- Once access obtained recommend catheter to be flushed with peritoneal dialysis fluid 2L 1.5% or 2.5% dextrose solution with 500U/L (1000u total) Heparin added. The flush is 500cc infused and immediately drained. We repeat this for the entire 1500 or 2000cc bag. Can Start dwells at this time or hold overnight.
 - Alternatively, after checking for proper placement and flushes, instill 6000u (6ml of 1000u/ml heparin) into the transfer set if not being used immediately otherwise after the solution is allowed to run in.

PD training videos

1. <https://www.pdempowers.com/hcp/hti/nurse-forum/hospital-and-skilled-nursing-facility-personnel-module1-fundamentals-of-pd>
2. <https://www.pdempowers.com/hcp/hti/nurse-forum/hospital-and-skilled-nursing-facility-personnel-module2-clinical-interventions-for-common-complications-in-pd>
3. https://urldefense.proofpoint.com/v2/url?u=http-3A_players.brightcove.net_1992769035001_default-5Fdefault_index.html-3FvideoId-3D6032170902001&d=DwIFAg&c=j5oPpO0eBH1iio48DtsedeElZfc04rx3ExJHeIIZuCs&r=Ue7cNPZQlfHsiq6_gBp8xGgSIPqKXiy_AY8eJLmMH4&m=IjTKvGk0jfMJETAHrkYf5IcdA1EveoyQsQtn4vTNsLM&s=fsSIZO0NRIv6e3IeGGHTKYicxo74ExOXC0X6a99bAyg&
4. https://www.youtube.com/watch?v=-FDbo_e2oAM

PD supplies for each site assuming 10-15 pts per site with product order numbers:

PD fluid (Dianeal/Extraneal (Baxter) or Stay Safe (Fresenius)) - the 2L low volume bags to start
Approximately 45-60 bags per patient for 2-week time period. Assuming 15 patients ○ 15daysX15
patientsX60=900bags of solution. We recommend 2L bags. (need to adjust below numbers based
on the anticipated needs at your institution)

- Dianeal (Baxter) 2L Boxes (6/box)
 - 1.5% Dextrose (5B9766)
 - 2.5% Dextrose (5B9876)
 - 4.5% Dextrose (5B9796)
 - Extraneal (Baxter)-For overnight dwells (8-16 hours) 1 bag per night per patient
 - 30 boxes of 2L (6 per box) (5B4986)
 - Stay Safe Fluid (Fresenius) 2L bags (5 per box)
- 1.5% Dextrose (054-20221)
- 2.5% Dextrose (054-20222)
- 4.25% Dextrose (045-20224)

Ultraclamps (Baxter) (12/Box) or any tubing clamps (can buy on amazon)-use 2 per exchange per patient. Can wash and reuse

- 20 boxes (5C4957)

Minicaps (Baxter) (60/box) or Stay Safe Cap (Fresenius)(40 per box)

- 60 Boxes (5C4466P)-Baxter
- 80 Boxes (050-95012)-Fresenius

Spring Scale-recommend one per patient is best but, in a pinch, can share (or estimate). Also, can buy similar on Amazon

- 20 scales (5K3582)-Baxter
- Ohaus Spring Scale (36-8008-9)-Fresenius

Alcavis 50 (500ml/bottle) (Baxter) or ExSept (Fresenius)

- 20 Bottles (5K4005)-Baxter
- 20 Bottles (15117)-Fresenius

Transparent Dressings (50 per box) (Tegaderm or similar)

- 5 Boxes (5K7579M)-Baxter

Transfer Set:

FMCNA Stay Safe Set 18 inch (050-95005)-start with 30 (one per patient needed) (Fresenius)

Minicap extended life PD Transfer set 6''(6/box) (5C4482) This is a change to the twist clamp and need extra so new product # (Baxter)

- 10 boxes (need extra transfer sets if using extension tubing)

Stay Safe Organizer (Fresenius)-one needed per patient (030-10807)- -Makes it easier to use the stay safe bags but not essential. There is a holder too that connects to the IV poles, but I would not recommend as might risk the PD catheters getting inadvertently pulled out if the pole is moved.

- Would start with 30 organizers (Fresenius)

Warming Device (5K3961) or heating pad or warmer used for CVVH solution can be used to warm PD fluid (not essential)

- 15 warming devices

Sterile drain extension line, 12 feet (5C4464P)-Baxter only. For use if putting the fluid outside the room

- 30 drain lines
- 30 drain sets (026-20226, 10/box – Fresenius)

Catheter Placement: 15/each

Catheters: PD catheter kit: Merit VPL 511

Marcaine or lidocaine (what % is typically stocked and used)

OR basic tray or DPL kit

Scalpels: #5, #10, #11 Blades

1L NS for infusion to check placement needed at the time of placement

Sutures: 3-0 vicryl

4.0 monocryl

3-0 nylon

Transfer set (connection that stays on attached to the catheter)

Heparin 6ml (1000u/ml) to be infused by the surgeon and left to dwell in the catheter (including the transfer set) if not used immediately

Merit Supplies

1. Catheters: recommend the classic catheters. They come in three sizes. The difference is the length and distance between cuffs. Should get 15-20 to start
 - Classic adult small -3 catheters (CF5250)-Or avoid, can primarily use standard size.
 - Classic adult standard-12 catheters (CF5260)
 - Classic adult large-5 catheters (CF5270)
2. VP-511 PD implantation system 15-20 kits-one per patient needed (can be substituted with OR kits if not available)
3. Repair kit (CE-1400)-I think should have 2 in case the cap or connector is damaged
4. Faller Trochar (FT1100)-apparently helps with difficult patients. 3 (not essential but can be helpful)
5. Fluid administration kit-used to flush post implantation. (K08-02385) (not essential)

The clinical educator from Merit: Jacquie Logue 801-712-1321





A 12-foot cyclor standard drain line extension (life hack) can extend from usual PD catheter transfer set by 12 feet (Baxter only). A second transfer set is attached at the end of the extension. All CAPD modalities can be performed either outside of the patient room or at a distance that is consistent with COVID-19 distancing recommendations. Multiple extenders can fit together so it can be even 24 ft.

MERIT CONTACTS

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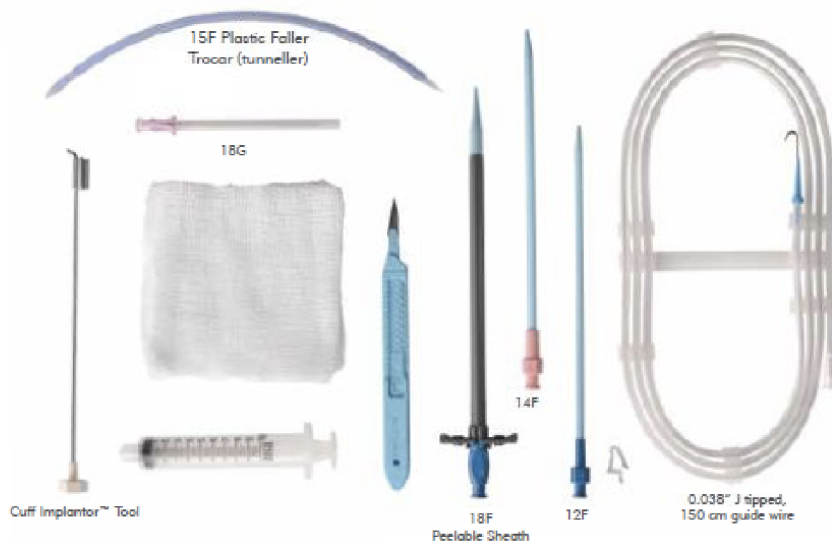
Jacque Loque (call first for clinical questions)

Sr. Director, Clinical Education Peripheral Intervention

1-801-712-1321 jloque@merit.com

Percutaneous Catheter Implantation

VP-511 PERCUTANEOUS IMPLANTATION SYSTEM With Antegrade Catheter Faller Trocar



**Suggested for Ultrasound
Guided Access and
Fluoroscopic Placement**

- VP-511 Implantation System
- PD Catheter Kit
- CC-2300 Titanium Catheter Connector
- (Optional) MAK.NV™ Introducer System
- (Optional) Merit Laureate® Hydrophilic Guide Wire

FT-1100 Metal Faller Trocar



ExTended™ Catheter Kits

CF-5560 AND CF-5570 COMPLETE EXXTENDED CATHETER KITS

Complete ExTended™ Catheter Kit available in two configurations for upper abdomen and pre-sternal procedures. Unique site-to-site measuring tools designed for precise placement.

