

Peritoneal dialysis

PD is a relatively simple form of dialysis which provides the motivated patient with the ability to perform dialysis at home, at work and at leisure. Travel is much easier, dietary and fluid restrictions are fewer and many patients value their independence from hospital.

Continuous ambulatory PD (CAPD): involves up to 4 exchanges a day of volumes of 1.5-3 litres (usually 2) of fluid.

Automated PD (APD): uses a bedside machine to allow exchanges to occur overnight and to instil fluid before waking. This final exchange usually remains in until connecting to the machine again at nighttime. APD is the preferred modality for most patients and has obvious advantages, but is not suitable for all - especially "low transporters". The available machines are called "Home choice" (Baxter) and "Sleepsafe" (Fresenius).

Peritoneal dialysate comes from two manufacturers, and in multiple formulations as follows:

Baxter:	1.36%, 2.27% & 3.86%, all glucose based Icodextrin (Extraneal) (polymeric high osmolality) Physioneal (bicarbonate buffered, dual chamber bags) Nutrineal (amino acid based)
Fresenius:	Numbers 2,4 & 3 (this order is correct for increasing glucose concentration!) Balance (low GDP, physiological pH)
<i>Low calcium versions of most of the above are available</i>	

NOTE: Icodextrin and blood sugar measurements: maltose is a degradation product of icodextrin that can cause falsely high readings with some commonly used blood glucose monitoring devices. Hypoglycaemia can therefore be mistakenly excluded in diabetics, or hyperglycaemia diagnosed in any patient, with potentially serious consequences. For diabetic patients receiving icodextrin we provide a monitor that avoids this hazard, the Medisense Optium monitor, but monitoring is still likely to be performed elsewhere. Patients must be made aware

of this potential problem, and icodextrin should be prescribed with caution to diabetics.

PD catheter insertion: Done by the Transplant surgeons laparoscopically under GA. The patient should be seen by the CDT prior to insertion, and the preferred exit site marked with a 5×5 cm box, taking into account belt line and the patient's line of vision. Laxatives, chlorhexidine wash, and appropriate instructions are given one week before surgery. Antibiotic prophylaxis for this procedure is 1gm IV flucloxacillin in theatre, or 400mg IV teicoplanin for those who are penicillin allergic.

As of late 2011, the intention is to screen patients who are planned to do PD for meticillin-sensitive Staph. aureus carriage and eradication therapy (as per MRSA carriage, detailed elsewhere) is to be prescribed if found to be positive.

Tubing change: PD catheters have an end-piece attached that allows exchanges to be performed. This end-piece requires regular replacement - 6 monthly for the Baxter system and yearly for the Fresenius

PD peritonitis: Signs and symptoms include abdominal pain, pyrexia, and/or cloudy PD effluent, but these may not all be present initially. The large volumes associated with APD may make cloudiness less apparent. Patients with any of these features must be reviewed and samples taken from their PD bag. If they do not have their own transport fix a 2-hour emergency ambulance. A fluid white cell count of $\geq 100/\text{mm}^3$, or a differential wcc of $>50\%$ neutrophils on any total wcc is diagnostic. Initial microscopy is often not helpful but treatment should not be delayed after cultures are sent. Immediate management is:

- vancomycin 30mg/kg dry body weight intraperitoneally, as a single 6h dwell;
 - Vancomycin dose should be calculated according to the patient's residual urine output (in Edinburgh, see on Proton under 'urine chem') as follows: Residual urine <200 ml/day, give 30mg/kg dry body weight
 - Residual urine >200 ml/day, give 37.5mg/kg dry body weight
- oral ciprofloxacin 500mg bd.

Most patients are allowed home, but admission may be required for pain control, systemic upset etc.

Decision regarding subsequent therapy will be made by the PD team on the basis of culture results and sensitivities. In Edinburgh approach the team for advice in prolonged, difficult or inpatient cases. Failure to improve suggest fungal or secondary peritonitis (see below), or just a bad infection. Catheter removal is often necessary in such cases and should not be delayed.

Fungal peritonitis

Rare, but serious with high morbidity and mortality. The priority is catheter removal. Pending surgery, yeasts should be treated with oral fluconazole 200 mg daily, continued for 2 weeks after catheter removal, and other fungi require amphotericin or flucytosine.

Secondary peritonitis

When there is a failure of clinical improvement, particularly with Gram negative or mixed organisms, a surgical cause should be sought. Where necessary seek a surgical opinion, asking for not only catheter removal if appropriate, but either a laparoscopic search for pathology or a mini-laparotomy.

Troubleshooting Peritoneal Dialysis Problems

Exit-site infection

Most poor drainage is temporary and is due to the catheter being caught in amongst loops of bowel. Administration of half a sachet of Picolax whilst stopping PD for a short period is usually curative. Poor drainage due to fibrin deposition sometimes occurs, particularly in relation to peritonitis and may be eased by the use of IP heparin at a dose of 500units/litre. A minority of cases are caused by adhesions, kinking, malposition or omental plugging and usually require surgery. PD catheters are highly mobile, so that the finding of a 'displaced' catheter on X-ray therefore means little in relation to poor drainage. So don't do them unless there's a really strong reason. There is absolutely no need for lateral pelvis films, which give a very high radiation dose.

Bloody bag

Bloody PD effluent can be frightening but is usually benign. In women it can occur during menstruation or at ovulation. In most cases the patient can be reassured and sent home. Rarely it may be seen in a leaking aortic aneurysm or other intra-abdominal crisis.

PD leak

A leak of PD fluid from the peritoneum to the abdominal wall may be suspected by increasing flank oedema in the absence of other fluid accumulation, and in association with poor fluid drainage. Proving this can be difficult. Ultrasound may detect a defect in the anterior peritoneum, usually in relation to the catheter. The most sensitive test however is CT scanning of the abdomen using a contrast-filled bag that has been in place for at least one hour prior to the scan (100mls contrast is diluted into one bag; PD nursing team do this on the ward). Treatment is usually by rest and / or a period of nocturnal APD with no daytime exchanges (to minimize intra-abdominal pressure). Haemodialysis is sometimes necessary.

Contaminated line

Patients who may have (if there is any possibility) inadvertently disconnected their system and contaminated their line should receive prophylactic antibiotics in the form of a single dose of vancomycin 500mg given intraperitoneally and left in-situ for six hours.

Sclerosing encapsulating peritonitis (SEP/ESP)

SEP / ESP is a potential complication of peritoneal dialysis. It involves sclerosis of the visceral peritoneum, often with bowel obstruction and failure of dialysis. There is no accepted treatment though nutritional support is essential. SEP is often fatal. Much debate continues over its exact aetiology, but it is undoubtedly associated with longer periods on PD; it remains controversial how long patients should be kept on PD as a result. As there is no clear guidance with regards this, the only absolute recommendation is that young patients should not regard PD as being a long-term therapy.

Dialysis adequacy

Measurement of PD adequacy requires collection of PD effluent, urine (for residual function) and blood. Adequacy should be checked regularly and after any problems, and the regimen adjusted in response. Measurement should not be performed for the first 8 weeks of treatment, but then every 4-12 months. Residual renal function is significant in most people who are doing well on PD.

There is continuing controversy about acceptable targets for PD, but it seems likely that too little dialysis is bad. Weekly creatinine clearance and Kt/V are the accepted measurements. The latter is more dependent upon PD, the former on residual renal function, and there may be marked discrepancies between the two. Currently accepted minimum targets are: (K/DOQI and our own):

CREATININE CLEARANCE at least 60 litres per week/1.73m² (50 l/week in low transporters) (normal creat clearance is around 1000 litres per week)

TOTAL Kt/V at least 2.0 per week (1.7 in low transporters)

For a description of how to measure Kt/V and creatinine clearance on PD, contact the CDT, or read UpToDate.

Peritoneal Equilibration Testing (PET)

The PET test describes how rapidly solutes are absorbed from the peritoneum in a standardised manner. Basically, higher rates of solute transfer are good for biochemical clearance of small molecules, but bad for ultrafiltration. Low transporters may receive poor dialysis; they should benefit from long dwell times (eg CAPD). Fast transporters may demonstrate inadequate ultrafiltration, and may benefit from rapid-cycling PD (e.g., APD). The PET test is performed first at 3 months into treatment, and thereafter as indicated. The test uses a standard 2 litre 2.27% or no. 4 bag, which is left in-situ for 4 hours. Blood and PD fluid samples are taken for creatinine and glucose at 0, 2 and 4 hours and are used to assess D/P ratios. See the CDT for the full protocol, and for tables to interpret the results, or the very good section in UpToDate.

Acknowledgements: Paddy Gibson was the main author for this page. The last modified date is shown in the footer.