1 BACKGROUND

In Leicester the rate of PD peritonitis is on average one episode in 19 months PD treatment. However this obscures the large variation in rate between different patients. Prevention of a first episode of peritonitis is dependent on careful patient selection, good surgical technique and post operation care, thorough training and continued supervision. This has resulted in a lengthening of the median time to first peritonitis amongst patients on PD in Leicester.

If a patient develops peritonitis 88% will still be alive and on peritoneal dialysis one month after the episode. This has remained unchanged in Leicester over the last six years. This can be improved with attention to accurate diagnosis, correct initial treatment and attentive follow-up of patients who present with suggestive symptoms. These guidelines are designed to help with that process.

More recently a higher proportion of patients appear to develop peritonitis relapse or recurrence. In light of this the guidance has been altered to clarify the addition of doxycycline (as well as, not instead of conventional treatment) on gram positive relapse/recurrence. In line with the 2010 ISP guidelines the length of treatment course for Staph Aureus, Enterococcus, and gram negative organisms has been increased to 21 days.

2 STANDARDS

The current recommended standards for the incidence of PD peritonitis are contained in the renal standards document of the renal association. In summary the standards are:

2.1 Overall peritonitis rate of less than 1:18 patient months
2.2 Culture negative rate in patients with clinical peritonitis less than 10%
2.3 Initial cure rate should be >80% without catheter removal

The renal unit audits performance against these standards on an annual basis. The results of previous audit is available on the renal unit shared M drive.

3 DEFINITION

PD Peritonitis is defined as two out of three of the following

A. Symptoms and signs of peritoneal inflammation
B. Cloudy dialysate with total WCC of greater than 100/mm³, of which > 50% neutrophils
C. Demonstration of organisms by positive gram stain or culture
4. **DIAGNOSIS**

1.1 PD peritonitis should be suspected in any patient on PD (or resting with a PD catheter in-situ) who has abdominal pain, cloudy dialysate or unexplained fever.

1.2 Clinicians should remain vigilant to the possibility that although the patient is on PD, they can have an alternative cause of peritonitis or abdominal pain (such as perforated viscera) just as with any other patient.

1.3 Initial clinical assessment must include an assessment of cardiovascular state (shock, volume overload), gastrointestinal symptoms, time of last PD exchange and the current state of the patients PD exit site. The patients’ home circumstances should also be considered.

1.3.1 Visual assessment should be made of the patients spent dialysate. In order to maximise the likelihood of positive culture the PD dialysate sent for microbiology should have spent a minimum of two hours dwell in the peritoneal cavity. Often patient bring their last dialysis bag with them. If this is cloudy on inspection and had dwelled for more than 2 hours it should be sent promptly for microbiology. If no bag was brought then the patients’ current bag should be drained out and inspected.

1.4 If a patient has symptoms of peritonitis, but the bag is clear then allow a further bag to dwell for at least two hours before reassessment. This is particularly important for patients on APD in whom the previous dwell may have been short.

1.5 Once a decision is taken to send a sample for microscopy it should be transported promptly. The likelihood of successful culture declines significantly if the dialysate is delayed more than four hours before it is placed under culture conditions.

1.6 Dialysate which appears clinically transparent is unlikely to contain significant numbers of WCC. Microbiology will not culture any bag which on microscopy contains 5 WCC or fewer. It is generally agreed that any organism cultured in this situation will likely represent contamination and not true peritonitis.

1.7 If there are greater than 5 WCC the bag will go on to be cultured, and the microbiology technical staff will phone back a total WCC and Gram stain. Differential WCC can be requested if there is clinical uncertainty about whether the patient has bacterial peritonitis or an allergic reaction.

1.8 Patients with significant abdominal pain often derive symptomatic relief with three PD flushes of a 1.36% dialysate drained into and immediately out of the peritoneum. These bags should not be sent for culture however as they have had insufficient dwell time.

1.9 To avoid delay, empirical treatment should be started immediately the samples have been taken, especially in patients who are clinically unwell. In clinically unwell patient’s blood cultures should also be taken. In patients with an inflamed PD exit site this should also be swabbed.
2 INITIAL TREATMENT (Day Zero)

2.1 Policy

2.1.1 Empirical antibiotics should be started in any patient with clinical peritonitis and greater than 100 WCC/mm$^3$ on microscopy. Empirical antibiotics are also indicated in those patients with fewer than 100 WCC/mm$^3$, but in whom there is a high clinical suspicion of peritonitis. In the latter case a clear plan must be made to review the diagnosis and treatment after 48 hours of empirical treatment.

2.1.2 Empirical treatment of PD peritonitis is with a bolus of intraperitoneal vancomycin and/or oral ciprofloxacin (“APD protocol”).

2.1.3 An alternative empirical INPATIENT treatment in patients on CAPD is with intraperitoneal vancomycin and/or gentamicin into each new bag of dialysate.

2.1.4 Alternative empirical INPATIENT treatment in patients on APD. A senior clinical opinion should be sought in patients on APD who are admitted to hospital as whether to convert them to CAPD for their inpatient stay (section 2.1.3), or to use the outpatient regimen (section 2.1.2)

2.1.5 Second and third line antibiotic protocols are available for use in patients who have had a previous allergic reaction to either vancomycin or gentamicin.

2.2 Procedure

2.2.1 Bolus Vancomycin + Oral Ciprofloxacin (“APD protocol”)

2.2.1.1 Gram positive organisms seen. Patient should be given a stat IP dose of vancomycin dependent on body weight

Patient weight of 20-40 kg = 1 g  
Patient weight of 40-70 kg = 1.5 g  
Patient weight greater than 70 kg = 2 g (can be up to 2.5 g)

Historical concern regarding rapid infusion of fluid containing vancomycin precipitating allergic reactions have not been borne out in extensive experience in surrounding dialysis units. The PD bag with vancomycin should be drained in with roller clamp fully open and the bag allowed to dwell for six hours [Keane et al 1995]. It should NOT dwell overnight.

2.2.1.2 Gram negative organisms seen. Patients should be given ciprofloxacin 500mg twice per day orally.

2.2.1.3 No organisms seen on gram stain. Patients should be given both antibiotics

2.2.2 Four times per day IP vancomycin and gentamicin (Inpatient CAPD regimen)

2.2.2.1 Gram positive organisms seen. Patient should be given 10 days of vancomycin at 25mg/L per dialysis bag. For patients with 2L and 2.5L bags use 50mg per bag, and those few patients using 3L bags use 75mg per bag.
2.2.2.2 Gram negative organisms seen. Patient should be given 10 days of gentamicin at 5mg/L per dialysis bag. For patients with 2L and 2.5L bags use 10mg per bag, and those few patients using 3L bags use 15mg per bag.

2.2.2.3 No organisms seen on gram stain. Patients should be given both antibiotics

2.2.3 Second and third line antibiotic regimens

2.2.3.1 These are to be used only in patients with documented previous allergy. They are generally not available routinely in pre-filled syringes. This does not prevent patient discharge, but necessitates a robust follow-up arrangement to supply the patient these antibiotics following the initial dose.

2.2.3.2 Allergy/contraindication to gentamicin

Prescribe ceftazidime 125mg/litre of dialysis fluid into each bag. Ceftazidime is available in 250mg vials. The powder should be dissolved in 5mls of water for injection and added to the CAPD bag. Prescribe intraperitoneal vancomycin 25mg/litre as well.

2.2.3.3 Allergy/contraindication to both gentamicin and cephalosporins

Prescribe oral ciprofloxacin 500mg twice daily. Prescribe intraperitoneal vancomycin 25mg/litre as well.

2.2.3.4 Allergy/contraindication to vancomycin

Teicoplanin can be used with caution. Prescribe 400mg of teicoplanin into the first bag and then 40mg/litre into each subsequent bag.

Teicoplanin is available in 400mg and 200mg vials

For addition to peritoneal fluid 200mg vial should be dissolved in 5mls of water for injection. Each ml contains 40mg of teicoplanin.

Prescribe gentamicin 5mg per litre as usual

2.2.3.5 Allergy/contraindication to both vancomycin and teicoplanin

Prescribe oral doxycycline 200mg once daily. Prescribe intraperitoneal gentamicin 5mg/litre as above. Warn the patient that the fluid draining out may develop a yellow or pink colour.

3 SUBSEQUENT TREATMENT AND FOLLOW-UP

3.1 Policy

3.1.1 The culture result and patient clinical condition should guide subsequent management.

3.1.2 Failure to make clinical improvement must prompt a thorough re-assessment of the patient.

3.1.3 The results of PD fluid culture are available between 48 and 72 hours after patient presentation. For patients who are outpatients it is the job of the day-case staff to chase-up outstanding results of patients who have presented with peritonitis. The blue “Peritonitis Episode” forms are designed to act as a reminder to do this.

3.1.4 In patients who are making clinical improvement the following changes to
treatment should be made based on the culture results.

3.1.4.1 Gram positive organisms. Patients on “APD protocol” should receive minimum 14 day treatment with bolus IP vancomycin (see below section 3.2). Those on
four times per day IP vancomycin should complete the 10 day course of IP vancomycin. Patients should stop gentamicin or ciprofloxacin if taking this.

3.1.4.2 Gram negative organisms. Patients should stop vancomycin and complete a minimum 14 day course of either IP gentamicin or oral ciprofloxacin.

3.1.4.3 No growth on culture. Patients should be treated as section 3.1.4.1 as if gram positive organism. The presumption is that the causative organism is a fragile or slow growing gram positive organism (such as a streptococcus).

3.1.4.4 Patients with Staphylococcus aureus, Enterococcus, or single gram negative organisms (E.coli, Proteus, Klebsiella or stenotrophomonas), or any patient with a severe infection requires a longer minimum treatment length of 21 days.

3.2 Procedure

Further bolus doses of intraperitoneal vancomycin in “APD protocol”

3.2.1 It is clear that patients with significant residual renal function are able to clear vancomycin relatively quickly, and some patients will require re-dosing with vancomycin at day four.

3.2.2 All patients treated using “APD protocol” will have a plasma vancomycin level taken at day 4. It is anticipated that this will occur in either the ward 10 day-case unit, or a suitably staffed satellite unit first thing in the morning. If day 4 is a Sunday it is acceptable to perform this step on day 5 (Monday).

3.2.3 Patient requires a clinical assessment. If peritonitis resolving and able to inject own bag then patient to be sent home with pre-filled syringe of vancomycin according to body weight (section 2.2.1.1). If unable to inject patient must stay in unit to wait vancomycin level known.

3.2.4 Vancomycin level must be chased up once assayed at approximately 2pm daily.

3.2.5 If level < 15mg/ml then

3.2.5.1 If patient at home; phone and instruct to inject pre-filled syringe into bag. If still in unit then staff to do this. Instill bag into patient abdomen and instruct patient to drain out after 6hours.

3.2.5.2 Further vancomycin levels are required at days 8 and 12, with further vancomycin on days 8 and 12 if level < 15mg/ml as above.

3.2.6 If level > 15mg/ml

3.2.6.1 Defer second bolus of vancomycin to day 7. If patient at home they can be instructed to add the pre-filled syringe of vancomycin to the next PD bag. If patient unable to self inject patient must return to unit on day 7 for vancomycin.

3.2.6.2 No further vancomycin levels necessary – give second bolus of IP vancomycin on day 7 as section 2.2.1.1
4 SPECIAL CASES

4.1 Pseudomonas peritonitis

4.1.1 Pseudomonal peritonitis is potentially very serious and often difficult to treat without removal of PD catheter.

4.1.2 Any patients who grow pseudomonas on PD culture should be recalled the same day for reassessment and senior consultation

4.1.3 Treatment needs to include at least two effective anti-pseudomonal antibiotics. In general this should be gentamicin 7.5mg/L in alternate bags, and ciprofloxacin 750mg twice per day orally. The sensitivity of the organism to these antibiotics must be confirmed with the microbiologist. Provided the patient makes clinical improvement this regimen should be continued for four weeks.

4.1.4 Patients must be assessed at least weekly, during which a random gentamicin level must be checked.

4.1.5 Failure to make clinical improvement, particularly in the context of pseudomonal exit-site infection should result in PD catheter removal, and rest off PD.

4.2 Stenotrophomonas

4.2.1 The isolation of a Stenotrophomonas organism, while infrequent, requires special attention since it displays sensitivity to only a few antimicrobial agents.

4.2.2 Therapy is recommended for 3-4 weeks if the patient is improving.

4.2.3 Treatment with two drugs (chosen based on the sensitivities) is recommended: the most effective agents are usually oral trimethoprim/sulfamethoxazole (oral 960mg bd), IP ticarcillin/ clavulanate, IP ceftazidine and oral minocycline.

4.3 Fungal Peritonitis

4.3.1 The ISPD guidelines are explicit and advise catheter removal without delay in all cases of fungal peritonitis due to a very high mortality. The only exception to this would be a patient in whom removal of the PD tube would result in serious adverse consequences (discontinuing dialysis for example)

4.3.2 Advice must be sought from microbiology regarding choice of antifungal due to the possibility of resistance to imidazoles. The ISPD guidelines recommend a combination of two anti-fungal drugs till catheter removal and then both for an additional 10 days. Examples of regimens include two of amphotericin B, flucytosine and fluconazole.
4.4 Relapsing and recurrent peritonitis

4.4.1 Relapse is defined as the same organism giving clinical peritonitis within 4 weeks of end of antibiotic treatment. It probably represents inadequate treatment or colonisation of the PD catheter or peritoneum. Recurrence is the same organism occurring after this time, and may represent re-infection / poor technique.

4.4.2 Coagulase positive or negative staphylococci. Patients should be given 2 weeks doxycycline 200mg once per day as well as the conventional treatment with IP vancomycin above.

4.4.3 Patients should be given a flush PD catheter with UROKINASE 5000units in 5 ml left in catheter for 2 hours on 4th and either the 7th or 8th days of antibiotic course. For the urokinase flush procedure, see UHL guidance on “non-infectious complications of peritoneal dialysis” on sharepoint.

4.4.4 Coagulase positive staphylococci. consider tunnel infection/abscess

4.4.5 Gram negative consider intra-abdominal abscess and consider tube removal (particularly if no clinical improvement)

4.4.6 Relapsed pseudomonas peritonitis should be treated with tube removal

4.5 Patients who are resting off PD

4.5.1 A first flush in any patient who has been resting off PD will often appear hazy. In the absence of symptoms or signs of peritonitis this initial bag does not need to be sent for microscopy or culture. If subsequent bags remain cloudy, or the patient has symptoms or signs of clinical peritonitis then the bag should be sent for examination in the normal manner.

5 PROCEDURE FOR ADDITION OF VANCOMYCIN AND GENTAMICIN TO PD BAG

Dose: Vancomycin 25mg/litre and gentamicin 5mg/litre PD fluid for 10days.

5.1 Vancomycin

5.1.1 Add 10mls of water for injection to a vial of vancomycin 500mg.

5.1.2 Mix gently to dissolve the powder.

5.1.3 Attach a label with details of the date prepared, patient name and the expiry time. (Expiry:- 24 hours after preparation)

5.1.4 Withdraw 1ml (50mg) from the vial and add to the peritoneal dialysis fluid.

5.1.5 Store the reconstituted vancomycin in the refrigerator and use for the next exchanges.
5.2 Gentamicin

5.2.1 Withdraw 1ml (10mg) from a vial of Gentamicin Paediatric Solution 20mg in 2mls and add to the peritoneal dialysis fluid.

5.2.2 Label the vial with the name of the patient, time and date and place it in the patient’s bedside locker for use at the next exchange.

6 MONITORING AND AUDIT

<table>
<thead>
<tr>
<th>Key Performance Indicator</th>
<th>Method of Assessment</th>
<th>Frequency</th>
<th>Lead</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD peritonitis rate, relapse and recurrence rates</td>
<td>UKRR quarterly audit data</td>
<td>Quarterly</td>
<td>J Medcalf</td>
</tr>
</tbody>
</table>

7 LEGAL LIABILITY GUIDELINE STATEMENT

Guidelines issued and approved by the Trust are considered to represent best practice. Staff may only exceptionally depart from any relevant Trust guidelines and always only providing that such departure is confined to the specific needs of individual circumstances. In healthcare delivery such departure shall only be undertaken where, in the judgement of the responsible healthcare professional it is fully appropriate and justifiable - such decision to be fully recorded in the patient’s notes.

8 REFERENCES


Accessible at: http://www.pdiconnect.com/content/30/4/393.full.pdf


8.7 Leeds Hospitals PD Peritonitis treatment guidelines. Dr Graham Woodrow.

8.8 Sheffield Hospitals PD Peritonitis treatment guidelines. Dr Martin Wilkie.
**8.9**  
Stoke Hospitals PD Peritonitis treatment guidelines. Dr Simon Davies.

**9 KEYWORDS (up to six)**

Peritoneal dialysis, PD, peritonitis, ERF, ESRF

---

### DEVELOPMENT AND APPROVAL RECORD FOR THIS DOCUMENT

<table>
<thead>
<tr>
<th>Author / Lead Officer:</th>
<th>James Medcalf</th>
<th>Job Title: Consultant Nephrologist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reviewed by:</td>
<td>Nephrology Consultants</td>
<td></td>
</tr>
<tr>
<td>Approved by:</td>
<td>Date Approved:</td>
<td></td>
</tr>
</tbody>
</table>

---

### REVIEW RECORD

<table>
<thead>
<tr>
<th>Date</th>
<th>Issue Number</th>
<th>Reviewed By</th>
<th>Description Of Changes (If Any)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun 2007</td>
<td>1</td>
<td>Dr J Medcalf</td>
<td>No changes.</td>
</tr>
<tr>
<td>Feb 2008</td>
<td>2</td>
<td>Dr J Medcalf</td>
<td>Change to Outpatients using entirely “APD protocol” with withdrawal of routine pre-filled syringes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Change to day 4 vancomycin level with 1.5g and 2g vanc pre-filled syringes.</td>
</tr>
<tr>
<td>Feb 2008</td>
<td>2.1</td>
<td>Dr J Medcalf</td>
<td>Added Procedure for adding vanc and gent to bags from Gill Hartley (Senior Renal Pharmacist).</td>
</tr>
<tr>
<td>Mar 2008</td>
<td>2.2</td>
<td>Dr J Medcalf</td>
<td>Altered urokinase flushes if recurrent coag negative to days 4 and 7or8 of the episode to fit with vancom level and re-dosing.</td>
</tr>
<tr>
<td>May 2008</td>
<td>2.3</td>
<td>Dr J Medcalf</td>
<td>Added “prompt chart” from Anil Permessur - Senior Staff Nurse. Adding advice on fungal peritonitis. Clarified that presentation is day 0 in the timescale. Allowed vancomycin level and redosing on Monday if day 4 is Sunday.</td>
</tr>
<tr>
<td>April 2010</td>
<td>3</td>
<td>J Medcalf S Bukhari</td>
<td>5.2.3.5 Antibiotic changed from Rifampicin to Doxycycline 7.2.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Antibiotic changed from Rifampicin to Doxycycline.</td>
</tr>
<tr>
<td>Mar 2013</td>
<td>4</td>
<td>J Medcalf</td>
<td>Section on the treatment of fungal peritonitis (deleted in version 3) re-instate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Empirical treatment of both inpatients and outpatients is now with bolus Vancomycin and oral ciprofloxacin (x4 day IP vanc and gent now uncommon).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Section added on length of treatment course different depending on severity and organism.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>New paragraph in introduction to highlight these changes and rationale.</td>
</tr>
<tr>
<td>Dec 2018</td>
<td>6</td>
<td>O Iyasere</td>
<td>Section on delaying starting treatment until WCC and gram stain available, edited. Minor grammatical errors corrected.</td>
</tr>
</tbody>
</table>