
Objective: To guide safe and appropriate selection of antibiotic therapy for Peritoneal Dialysis patients.

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Approved by: Clinical Standards Group (September 2009)

Evidence Base: Rank: B

Date of Issue: November 2009 Review Date: November 2012

Summary

This guideline is intended for doctors and nurses as a guide to treating peritoneal dialysis patients on the Aintree renal unit.

This guideline will be reviewed by the Aintree Hospitals NHS Trust Nephrology, Microbiology and Pharmacy team members as above.

Patients presenting with infections related to peritoneal dialysis catheters should be referred promptly to nephrology to enable their specialist management.
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**Diagnosis of peritoneal dialysis (PD) Peritonitis**

Patients may present with 2 of the following 3 features:-

1. **Signs and symptoms of peritonitis**
   - Abdominal pain or tenderness
   - Constipation or diarrhoea
   - Pyrexia

2. **Cloudy PD fluid** with PD fluid white cell count (WCC) >100/μL with >50% polymorphonuclear neutrophils.

Note: in patients on APD with short overnight dwell times the % polymorphonuclear cells may be a more useful diagnostic marker than WCC

3. **Microorganisms in the PD fluid**
   - Confirmed by Gram-stain or culture

The PD nurses or a member of the nephrology team MUST be made aware of any PD patient with a diagnosis or suspected diagnosis of PD peritonitis. In normal working hours the PD Nurse can be contacted on 07966 882953. Out of hours (or when PD Nurse cannot be contacted directly in normal working hours) contact should be made with ward 20 (extension 3814 or 8825), and the Nephrologist on-call must also be informed (via switchboard).

Any patient attending with suspected peritonitis will need to be discussed with the renal doctor on call (contacted through switch-board). The renal doctor will decide suitability for treatment as an outpatient (see Admission to hospital).

**Management of suspected PD peritonitis on initial presentation.**

If a patient contacts the renal unit complaining of a cloudy bag/effluent with or without abdominal pain they must be asked to attend ward 20 as soon as possible for assessment. Ask the patient to bring the PD fluid that they have drained out to the unit with them (this sample is the best to send for microbiological analysis).

In preparation for their arrival ensure that there is a 2litre CAPD bag of fluid on the heater plate. (Ask the patient which fluid they usually use, if it is for a night dwell and the patient is usually on APD use Extraneal).

On arrival to the ward drain the patient as if they were carrying out a CAPD exchange, observing their effluent. If the fluid is obviously cloudy the patient will require treatment for peritonitis.
All patients should have temperature, blood pressure and pulse rate recorded, blood taken for CRP, FBC and blood cultures if clinically unwell, and assessment of pain.

**Microbiological testing**

Sampling should ideally be performed *before* any antimicrobial treatment is initiated.

Aseptically withdraw **75mL** of drained PD fluid from the injection port of the PD bag using a sterile needle and syringe and transfer into 3 sterile universal containers.

Time of collection should be documented on all samples (this may be different to the time when the sample is requested on PCIS). Samples must be sent to microbiology immediately for urgent differential cell count, Gram stain, culture and sensitivity – testing will be performed during normal working hours (includes weekend laboratory hours), but not out of hours (apart from exceptional circumstances on discussion with the Nephrologist on call who will liaise directly with the Microbiology Team).

**Empirical antibiotic therapy:**

(IP = intraperitoneal administration)

- **Day 1:** IP vancomycin  stat dose, dwell time ≥6 hours  
  1.5g if weight <60kg  
  2g if weight ≥60kg

- **Day 1:** IP gentamicin  stat dose, dwell time ≥6 hours:
  
  - <50 kg give 30mg
  - 50-80kg give 40mg
  - >80kg give 50mg

Further antibiotic therapy will depend on the results of microbiology testing. If to be continued vancomycin and/or gentamicin should be prescribed at the same doses as above. See [further antibiotic therapy section](#) for more details.

Patients unable to receive vancomycin or gentamicin must be discussed with the renal doctor and/or microbiologist (to discuss the alternative options outlined in Appendix 3). A prescription for intraperitoneal antibiotics must be written on a standard card but must state for intraperitoneal use on the prescription.

Vancomycin and gentamicin can be added in the same dialysis solution bag without loss of bioactivity\(^2\), however separate syringes must be used to make the additions.

If the patient is experiencing pain prescribe oral paracetamol 1g 4-6 hourly prn (maximum 4g in 24 hours).
Intraperitoneal antibiotic administration

- **Patients on CAPD**

Once the sample has been taken, move to the next stage of the CAPD exchange ‘flush before fill’. ALWAYS TAKE SAMPLE PRIOR TO FLUSH.

During the ‘flush’ phase ensure that the fill volume left in the bag is the correct amount for that patient. i.e. if patient only fills 1500mLs, flush 500mLs out of the 2L fill bag into the drain bag.

Once the patient’s fill volume is left in the fill bag, add the antibiotics to the dialysis fluid via the additive port using sterile technique. Gently shake the bag to ensure antibiotics are mixed in, and then continue with the fill phase of exchange. Disconnect once fill completed as normal and advise the patient to leave the fluid in for a minimum of 6 hours. If patient is normally on CAPD, they can carry on with their usual regime after 6 hours.

- **Patients on APD**

In intermittent IP dosing regimes, the antibiotic-containing dialysis solution must be allowed to dwell for at least 6 hours to allow adequate absorption of the antibiotic into the systemic circulation.

The empirical antibiotic regime described above can be used in patients on CAPD and APD, however for patients on APD the six-hour antibiotic dwell is done in the “day bag”. The patient can have APD exchanges overnight as usual.

If the patient is normally on APD and they have attended during the night, advise them to miss that night's APD therapy, use a standard CAPD exchange to administer the antibiotics, then drain out in the morning and use their usual daytime PD exchange. They will then be able to carry on as normal the next night. (Remind them that they may have to 'by pass' initial drain, if they usually have a day dwell.)

If in doubt, discuss this with the PD nurses, renal doctors or renal pharmacists.

**Admission to hospital**

If the patient is systemically unwell (pyrexia, hypotension, rigors) or pain, nausea or vomiting is severe then the patient will require admission to hospital.

Please ensure that if a patient is admitted overnight or at the weekend, the PD team and the on-call renal doctor are made aware. Both can be contacted through switchboard. If admitted out of hours, contact ward 20 (ext. 3814 or 8825) to see if patient can be nursed safely on the Renal ward, either in a vacant bed, or with a plan to use the 9am discharge bed the following morning.
Indications for catheter removal

Patients with *relapsing* peritonitis (defined as an episode of PD peritonitis occurring within 4 weeks of completion of therapy of a prior episode with the same organism or one sterile episode)\(^2\) or *frequent episodes of peritonitis* (especially with the same organism) are likely to need surgical intervention either in the form of acute removal of their PD catheter or an elective tube change (removal and re-insertion).

In patients with *refractory* peritonitis (defined as failure to respond to appropriate antibiotics within 5 days) consideration should be given to catheter removal to protect the peritoneal membrane for future use\(^2\).

Patients with *fungal* or gram –ve peritonitis (especially pseudomonas) will almost always require urgent catheter removal except in exceptional circumstances. Refer to consultant nephrologist who will liaise with the surgical team for urgent catheter removal and the on-call microbiology team for advice on specific treatment.

Further antibiotic therapy

Further antibiotic therapy should be reviewed once culture results and sensitivities are available. The guidelines for therapy below are suggestions only and close liaison with microbiology is important. In particular, patients who are not responding to antibiotic therapy should be reviewed surgically with a view to laparotomy and catheter removal.
Gram-positive organism identified on culture

**Gram-positive organism on culture**
(result usually available after 48-72 hours)

**STOP gentamicin**

**Staphylococcus epidermidis**
(coagulase-negative staphylococcus) or other gram-positive organism.

- Continue IP vancomycin
- Check random serum vancomycin assay on day 4 and re-dose as per levels (see Appendix 1)

- Complete 14 days of treatment

**Staphylococcus aureus**

- Methicillin-sensitive (MSSA)
- Methicillin resistant (MRSA)

- Also use nasal mupirocin tds for 5 days and Octenisan® washes daily for 10 days

- Continue IP vancomycin
- Check random serum vancomycin assay on day 4 and re-dose as per levels (see Appendix 1)

- Complete 3 weeks of treatment

If no improvement by day 4, send PD fluid for cell count and discuss case with renal consultant and microbiologist.
Gram-negative organism identified on culture

Gram-negative organism on culture
(result usually available after 48-72 hours)

STOP vancomycin

Pseudomonas or Stenotrophomonas

Continue monotherapy according to sensitivities:
- Continue gentamicin daily at the same dose as was given empirically
  Check random serum gentamicin assay only if being used for >14 days (see Appendix 2)
  Catheter removal usually required for infection with these organisms. Consider urgent early catheter removal in discussion with the

If no improvement by day 4 send PD fluid for cell count and discuss case with renal consultant and microbiologist

Complete minimum 21 days of treatment

Other gram-negative organism

Continue monotherapy according to sensitivities:
- Continue gentamicin daily at the same dose as was given empirically
  Check random serum gentamicin assay only if being used for >14 days (see Appendix 2)

If no improvement by day 4 on gentamicin monotherapy send PD fluid for cell count discuss possible alternative regimes with Nephrologist and/or Microbiologist (see Appendix 3)

Complete minimum 21 days of treatment
"Culture-negative" peritonitis

The patient should always be asked about recent use of antibiotics for any reason, as this is a known cause of culture-negative peritonitis.

- Continue IP vancomycin and gentamicin
- Check random serum vancomycin assay on day 4 and re-dose as per levels (see Appendix 1)
- Check random serum gentamicin assay only if being used for >14 days (see Appendix 2)

- If no improvement by day 4 send PD fluid for cell count and discuss with Nephrologist and/or Microbiologist
- If no improvement by day 5 discuss case with renal consultant and microbiologist and consider catheter removal
- Complete minimum 14 days of treatment
Prevention of infections

• Screening

All patients should be screened for Staphylococcus aureus nasal carriage prior to PD catheter insertion. If a positive result is obtained then they should be treated with nasal mupirocin ointment applied to each nostril three times a day for 5 days and Octenisan® washes daily for 10 days.

All PD patients should then be screened at 3-monthly intervals after catheter insertion for nasal Staphylococcus aureus carriage and a positive result treated with eradication therapy as outlined above.

Any patient with Staphylococcus aureus PD peritonitis should be screened for nasal carriage and eradication therapy commenced as above.

• Prophylactic antibiotics following accidental touch contamination

Following a break in sterile technique, or if a split or damaged catheter line or extension is identified, the patient should be advised not to continue with the exchange and attend the renal unit for a stat dose of IP vancomycin (1.5g if weight <60kg; 2g if weight ≥60kg) and a change of catheter extension set.

Exit site and tunnel infections

An exit site infection is defined by the presence of purulent drainage with or without erythema of the skin at the catheter-epidermal interface. A positive culture from the exit site in the absence of inflammation is indicative of colonisation rather than infection. A tunnel infection may present as erythema, oedema or tenderness over the subcutaneous pathway but is often clinically occult².
Exit site or tunnel infection
Send exit site swab for culture and sensitivity

Commence empirical antibiotic therapy:
- Flucloxacillin 500mg po qds
  If penicillin allergic:
  - Erythromycin 500mg tds

If infection clinically severe (to be decided by Nephrologist or senior dialysis nurse) then also give vancomycin IP (1.5G if <60kg, and 2G if >60kg), plus gentamicin (30mg if < 50kg, 40mg if 50-80kg, or 50mg if >80kg) in the long dwell bag as stat doses only.

Complete 21 days treatment for culture negative/empirical therapy.

Gram positive organism identified:
Continue empirical oral therapy or adjust according to sensitivities.
Give nasal mupirocin tds for 5 days and Octenisan® washes daily for 10 days.

Gram negative organism identified:
Stop empirical therapy.
Start oral ciprofloxacin 500mg bd.
Counsel patient on tendenitis
If allergy or previous adverse reaction to quinolones, or history of epilepsy, discuss with microbiology. If Pseudomonas identified discuss with microbiology.

Continue treatment for 21 days and then review
Resolution
Stop treatment
Improvement
Re-swab, continue treatment for a further 2 weeks
No improvement
Discuss with renal consultant and microbiology
Appendix 1. Monitoring of serum vancomycin concentrations.

Vancomycin is administered IP as a 1.5g-2g stat dose depending on weight. (1.5g if weight <60kg; 2g if weight ≥60kg).

The dosing interval is dependent on residual renal function. Ideally, the timing of repetitive dosing should be based on trough levels. Intraperitoneal levels of vancomycin after the initial dose will always be lower than serum levels of vancomycin; therefore, the serum levels need to be kept higher than would be otherwise indicated.

Patients should receive another stat dose of vancomycin once trough serum levels have fallen to <20 mg/L\textsuperscript{1,2}.

In this protocol we have advised checking a random serum vancomycin concentration on day 4 (or 5 if not possible on day 4) of treatment:

- If the serum concentration on day 4 or 5 is 10-15mg/L the patient should receive another stat dose of vancomycin that day. A further concentration should be checked in 5 days time.
- If the serum concentration on day 4 or 5 is <10mg/L the patient should receive another stat dose of vancomycin that day and a further concentration checked in 2 days time.
- If the serum concentration on day 4 or 5 is 15-20mg/L the patient should receive another stat dose of vancomycin in 2 days time. A further concentration should be checked in 7 days time.
- If the serum concentration on day 4 or 5 is >20mg/L another concentration should be checked every 1-2 days and the patient re-dosed once levels fall to <20mg/L.

The renal pharmacists can provide further dosing advice based on the patient’s dosing history and serum concentrations.

Check random serum gentamicin levels if gentamicin being used for >14 days. Continue treatment at same dose as long as level is <2mg/l.

If level >2mg/l then discuss with Nephrologist, Pharmacist and/or Microbiologist to amend/reduce next dose.

Appendix 3. Alternative antibiotic choices and regimes (ONLY TO BE USED IN DISCUSSION WITH NEPHROLOGIST AND MICROBIOLOGIST)

Doxycycline 200mg po stat, then 100 to 200mg od depending on severity of infection. Warn patient of increased skin sensitivity to sunlight. This can be used in selected patients for gram+ sepsis and some patients with MRSA.

Rifampicin 300mg bd orally for up to 7 days. Warn patient of orange coloured urine and other bodily secretions. This can be used in selected patients for gram +ve sepsis.

Cephalosporins – can be used intravenously for gram –ve PD peritonitis, prophylactic treatment pre-cannula insertion, or tunnel/exit site infections (or for empirical treatment in culture negative cases) if standard therapy fails, or patient is sensitive/allergic to first line therapy.

Ciprofloxacin 500mg bd orally (or iv if patient unable to tolerate oral medication) can be used for gram –ve infections.

Appendix 4: Prophylactic Antibiotics for elective PD catheter insertion

Prophylactic antibiotics are recommended prior to elective insertion of a PD cannula. A stat dose of vancomycin 1g iv should be given within 12hrs of cannula insertion. If the patient is sensitive/allergic to vancomycin then flucloxacillin 2g iv or Tazocin 4.5g iv can be given 1hr before catheter insertion.
References


Further Acknowledgements:

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