

## **THE RICHARD BRIGHT RENAL UNIT**

### **INTRODUCTION TO THE CARE OF PATIENTS RECEIVING PERITONEAL DIALYSIS**

#### **SUMMARY**

Peritoneal Dialysis is an excellent way of maintaining patients in the community with end-stage renal failure who would otherwise be dependent on hospital haemodialysis. It offers patients independence and flexibility. The near continuous removal of fluid and uraemic metabolites results in “steady state” physiology and biochemistry, allowing even elderly patients and those with cardiovascular disease to tolerate dialysis treatment with few side effects. While some aspects of care of these patients will necessarily fall to the Renal Unit (e.g. biochemical and nutritional monitoring), there are many other clinical areas where genuine shared care is appropriate. These include non-renal medical, surgical and gynaecological problems, psychological and social aspects of illness, diabetes care, and assistance in the assessment of fluid balance.

#### **INTRODUCTION**

Peritoneal Dialysis is the therapy of choice for a large number of patients in the UK reaching End Stage Renal Failure and involves the use of the peritoneal membrane as a semipermeable membrane for dialysis. It has the advantages of allowing considerable independence, “steady-state” control of biochemistry, and it is easy for patients to learn to perform their own treatment at home. The alternatives are hospital haemodialysis, which requires three round trips to hospital per week, each session lasting approximately 4 hours (not including travelling time, which may be substantial), or home haemodialysis, which requires a period of training in hospital of up to 6 months. Renal transplantation is an option for some patients but, unless there is a potential living related donor such as a sibling or parent, depends on a suitably matched cadaveric organ becoming available. Demand for cadaver organs continues to outstrip supply.

To carry out Peritoneal Dialysis surgical insertion is required of a flexible semipermanent catheter through a subcutaneous tunnel below the umbilicus, with the tip in the pelvis. This is usually done under general anaesthetic. A 2 week healing period is left before use of the catheter for ambulatory dialysis, although if dialysis treatment is necessary, intermittent Peritoneal Dialysis can be performed with the patient in bed, often for 24 hour periods twice a week. This is followed by a short training period following which patients are discharged to the community. Follow-up frequency depends a great deal on patient's confidence and general condition, but stable patients need only attend for clinical review ever 3-4 months. They are followed up more closely by a named renal community dialysis nurse.

#### **PRINCIPLES OF PERITONEAL DIALYSIS**

Instillation of dialysis fluid containing glucose, lactate, and electrolytes into the peritoneal cavity allows:

1. Removal of fluid from the patient due to the osmotic ‘drag’ of the hyperosmolar glucose
2. Correction of acidosis (by absorption and metabolism of lactate)

3. Removal of metabolic waste products (urea, creatinine, phosphate, etc) by diffusive exchange across the peritoneal membrane
4. Correction of electrolyte imbalance

Dialysis fluid is introduced into the peritoneal cavity via the catheter using a no-touch sterile exchange and is then allowed to dwell for 4-6 hours, until the next exchange. Most patients carry out 4 exchanges a day: a small number of patients are instructed to leave the peritoneal cavity empty overnight. The continuous presence of fluid in the peritoneal cavity (apart from the time taken draining in and out) allows slow and almost continuous removal of waste products, avoiding rapid fluctuations in serum biochemistry.

Removal of fluid can be adjusted by altering the glucose concentration of the fluid. Three “strengths” of fluid are available:

LOW (Light). The fluid in a light bag has an osmolality only slightly higher than plasma osmolality, and contains 15 g/L or 13.6 g/L anhydrous glucose, depending on the manufacturer

MEDIUM. This fluid generates a moderate osmotic gradient favouring fluid removal and contains 22.7 g/L glucose.

HIGH (heavy). This fluid generates a marked osmotic gradient favouring fluid removal and contains 42.5 g/L or 38.6 g/L anhydrous glucose, depending on the manufacturer.

An alternative peritoneal dialysis fluid is ICODEXTRIN (“Extraneal”) which contains a glucose polymer. This exerts sustained ultrafiltration because the glucose polymer is not absorbed across the peritoneal membrane. Some patients with protein malnutrition may also be treated with an amino-acid dialysate (“Nutrineal”).

There is large inter-individual variation in the rapidity of biochemical equilibration across the peritoneal membrane. ‘Rapid transporters’ achieve early equilibration, can run into problems with fluid overload because of the rapid loss of an osmotic gradient and absorption of the dialysate into the circulation, and are sometimes better treated with automated peritoneal dialysis or with Icodextrin. ‘Slow transporters’ may not achieve adequate biochemical control unless treated with very high volume exchanges. Transport status is determined 6-8 weeks after starting peritoneal dialysis by performance of a “Peritoneal Equilibration Test” (“PET”). This test is performed in the renal Outpatient department and involves instillation of a medium strength bag for 4h. Dialysate samples are obtained at 0,2 and 4h and blood samples at 4h, allowing assessment of the ratio of peritoneal:plasma creatinine and the initial:final dialysate glucose. Results of the PET may be used to determine dialysis prescription.

Fluids are also available in 3 varieties of calcium concentrations. Most patients start Peritoneal Dialysis on a low calcium concentration (1.0 mmol/l).

The regimen chosen for a particular patient will be adjusted during the training period to achieve control of fluid balance, taking into account residual urine volumes and habitual fluid intake (most patients are advised to moderate fluid intake). Patients (or spouses or other helpers) are taught to monitor body weight daily, and to watch for the development of oedema. All patients are given a “TARGET WEIGHT” at which they are judged to be clinically euvolaemic. This target weight requires adjustment if the patient’s true body weight changes over time.

Volume overload results in a weight significantly above target weight, rise in blood pressure and eventually in the development of peripheral or pulmonary oedema. This

may mimic heart failure or asthma. Treatment is by decreasing fluid intake and use of higher strength bags of dialysate.

Volume depletion is commonly a result of vomiting and/or diarrhoea, and results in a weight significantly below target weight, muscle cramps, dizziness and nausea. A postural fall in blood pressure is the most reliable way of diagnosing volume depletion. Treatment is by increasing salt and water intake and use of "low bags" to prevent further fluid loss, while correcting the underlying cause. Severe cases will require intravenous fluids.

## **DIALYSIS FLUID ADMINISTRATION**

Dialysis fluid for Peritoneal Dialysis is supplied in 1.5, 2, 2.5 and 3 litre bags; the usual is 21, but small or large patients may have a different size prescribed. These are particularly useful for visually impaired patients or those with arthritis. All patients use a "DISCONNECT" system. A small but growing minority of patients are treated with Automated Peritoneal Dialysis, their PD exchanges being performed overnight by a machine adjacent to their bed.

## **BIOCHEMICAL CONTROL**

This is monitored at outpatient visits, applying the following criteria:

Potassium	3.5 – 5.5 mmol/L
Urea	15-25 mmol/L
Corrected Calcium	2.4 – 2.6 mmol/L
Phosphate	1.2 – 1.8 mmol/L

One of the problems in monitoring Peritoneal Dialysis is that serum urea is influenced not only by how efficiently urea is removed from the body by dialysis, but also by how rapidly it is generated from protein breakdown. In stable patients, the rate of urea generation is closely parallels protein intake. Thus a serum urea within the target range may conceal a combination of inadequate dialysis and inadequate protein intake. Because adequate nutrition is such an important determinant of outcome in dialysis patients, we now perform "urea kinetic modelling" (all patients at 6-monthly intervals). This involves a 24hour collection of dialysate and urine combined with a blood test, and must be backed up with careful dietetic monitoring. For similar reasons, low values for serum creatinine, potassium, and phosphate cause as much concern as high values. All patients are seen regularly by a renal dietitian.

Regular measurements of parathyroid hormone and alkaline phosphatase permit early detection and treatment of secondary hyperparathyroidism.

Cardiovascular disease is a major cause of death in renal patients. We are increasingly turning our attention to treatment of hyperlipidaemia in these patients who often have multiple other risk factors and thus have the most to gain from lipid lowering drug therapy.

## **COMPLICATIONS**

### **1. Peritonitis**

The major complication of Peritoneal Dialysis is peritonitis. Organisms may either be introduced through the catheter owing to lapses in sterile technique; by colonisation of the catheter; or from bowel disease. Peritoneal Dialysis peritonitis

usually presents with abdominal pain of variable severity, fever (sometimes) and cloudy peritoneal effluent. Because the last feature is the most reliable, blind patients sometimes present late. Hospital investigation is mandatory to allow accurate identification of the organism, and initiation of the appropriate intraperitoneal antibiotics.

## 2. Fluid Imbalance

In renal failure the patient's capacity to excrete a fluid load is reduced or absent. Fluid balance is maintained by adjustment of dialysate osmolality ("strength") to remove excess fluid, coupled with sodium and water restriction. Non-compliance with either can lead to volume overload, which presents in the same way as heart failure, with peripheral and pulmonary oedema. Fluid overload may also cause hypertension in renal patients. There is usually no response to diuretics, and the correct treatment is fluid removal by dialysis.

Fluid depletion is less common but may be caused by over-vigorous removal of fluid during dialysis or by intercurrent diarrhoea or vomiting. It usually presents with symptomatic postural hypotension (which is the most reliable physical sign) and with nausea and weakness. Treatment is by administration of salt and water, either orally or intravenously depending on severity, coupled with attention to the underlying cause.

## 3. Hypertension

In some patients, blood pressure remains high despite adequate fluid removal. These patients require antihypertensive medication.

## 4. Anaemia

Although Epoietin deficiency is the major cause, iron deficiency may contribute. The optimal response to epoietin requires the serum ferritin to be  $> 100$  ng/ml. Oral ferrous sulphate may be insufficient to correct deficiency, in which case day case Iron Dextran infusions are arranged. Folic acid is also removed by dialysis, but deficiency is only a problem if there is concomitant dietary deficiency. Once haematinic deficiency has been corrected and other causes of anaemia excluded, treatment of anaemia is with subcutaneous epoietin or with the longer-acting analogue darbepoietin.

## 5. Other vitamin deficiencies

Dieticians may advise multi-vitamin supplements for some patients whose intake is poor.

## 6. Bone Disease

Dialysis patients are at risk of osteomalacia (due to defective renal hydroxylation of vitamin D), hyperparathyroidism (due to phosphate retention, calcium malabsorption, and defective hydroxylation of vitamin D), and may also develop osteoporosis. These conditions may be asymptomatic in the early stages but may result in bone pain or pathological fractures.

## 7. Joint Disease

Patients on longterm dialysis are prone to the development of stiffness and aching in the joints, particularly the shoulders. This is related to accumulation of amyloid deposits. Treatment is difficult, but the symptoms respond to successful renal transplantation. Low dose steroid treatment may be effective.

#### 8. Vascular and extra-articular calcification

This is caused by hyperparathyroidism, phosphate retention, and positive calcium balance. Phosphate retention is treated by dietary restriction and by administration of “phosphate binders”.

#### 9. Cardiac Disease

Cardiovascular disease is responsible for much of the premature mortality of dialysis patients. This is nearly certainly due to the effects of longstanding anaemia, hypertension, and fluid overload on the myocardium, and to a high incidence of pre-existing atherosclerotic cardiovascular disease in patients presenting with renal failure. In addition, patients may develop calcification of the aortic and mitral valves associated with phosphate retention.

#### 10. Neuropathy

Patients may develop neuropathy due to vitamin B deficiency or to under dialysis: both of these are now very rare. Patients on long-term dialysis may also develop carpal tunnel syndrome due to amyloid deposition.

### **DRUG THERAPY**

#### 1. Blood Pressure

Hypertension is a major contributor to the excess cardiovascular mortality in renal patients. Many patients require antihypertensive therapy despite careful avoidance of fluid overload. Diuretics are usually ineffective. The choice of antihypertensive regimen is individualised, but may include beta-blockers, long-acting calcium channel blockers, ACE inhibitors, ATII receptor blockers, alphablockers, centrally acting agents (e.g. Moxonidine), hydralazine, and, occasionally, Minoxidil. Some of these drugs require dosage adjustment.

The aim is to maintain systolic < 130 mm Hg and diastolic < 80 mm Hg, although this target may be difficult to achieve

#### 2. Vitamin Supplements

We currently dispense a “black-listed” combination tablet (“Nephrovite”) which contains those water-soluble vitamins which are removed by dialysis but not those fat-soluble ones which may accumulate.

Vitamin D analogues are often needed to aid calcium absorption and to suppress hyperparathyroidism. Dose adjustment requires measurement of PTH, calcium, phosphate, and alkaline phosphatase. Two drugs are used: Alfacalcidol and Calcitriol, both with a usual dose range of 0.25 – 5.0 micrograms od. Occasionally large once weekly doses of vitamin D analogues are used, with the aim of suppressing hyperparathyroidism with proportionately less effect on calcium absorption. Vitamin D analogues also, unfortunately, increase absorption of dietary phosphate.

### 3. Calcium supplements and phosphate binders

Prevention of phosphate retention (which may contribute to vascular calcification, extra-articular calcification, and hyperparathyroidism) is by dietary restriction of phosphate combined with oral “phosphate binders” which limit absorption of dietary phosphate. Aluminium hydroxide was used extensively in the past for this purpose but has now been largely abandoned owing to the long-term risks of aluminium absorption. Calcium carbonate (Calcium 500, Calcichew, or Titalac, 3-9 tabs a day with meals) is most widely used, although use may be limited by the development of hypercalcaemia. Use of dialysate with a lower calcium concentration helps to avert this problem, but may result in negative calcium balance if compliance with calcium supplements is poor. Calcium acetate has better phosphate binding capacity and should be used in preference to calcium carbonate if the patient is being treated with an H<sub>2</sub> antagonist or proton pump inhibitor. Sevelamer hydrochloride (“Renagel”) is a newly introduced and expensive phosphate binder which contains neither calcium nor aluminium. The use of this drug may reduce the risk of progressive vascular calcification, but cost prevents its widespread adoption at present.

### 4. Iron supplements

These are not routinely used but may be necessary in patients with occult bleeding, menorrhagia, or low iron stores, particularly if also receiving Erythropoietin. Because renal failure *per se* results in anaemia, regular measurements of serum ferritin are needed to guide therapy. Iron supplements are routinely given to patients on Erythropoietin. Occasionally, intravenous iron supplements are necessary.

### 5. Hormone Replacement

Renal failure is not a contraindication to HRT in postmenopausal women and prevention of osteoporosis may be particularly valuable because of the limited exercise capacity and propensity to renal osteodystrophy of renal patients. HRT also has beneficial effects on cardiovascular risk factors. For these reasons we encourage the use of HRT.

### 6. Vaccinations

Renal failure is listed as a positive indication for influenza vaccination by the Dept of Health, because of the increased risk of severe infection in debilitated patients. Pneumovax may also be of benefit.

### 7. Antipruritics

Many renal patients develop intractable itching, the pathogenesis of which is multifactorial. Benefit may be derived from emollients (e.g. E45 cream), antihistamines, and sometimes weak steroid preparations. Attention to biochemical control, particularly of calcium and phosphate, is also thought to be important. Uraemic pruritis may be refractory, and sometimes requires dermatology referral, for instance for consideration of ultraviolet B therapy.

### 8. Epoietin (Erythropoietin) and Darbepoietin (“Aranesp”)

UP to 80% of CAPD patients require treatment with epoetin, or the newly introduced long-acting analogue darbepoietin. These are given by subcutaneous injection, twice or thrice weekly (for epoetin) or once weekly (for darbepoietin). These expensive drugs will be prescribed by the Renal Unit. Monitoring requires a fortnightly full blood count in the initiation phase and a monthly full blood count in the maintenance phase.

## **AREAS FOR SHARED CARE**

### 1. General clinical care

Many dialysis patients will consult you with respiratory, gastrointestinal, dermatological, and other illnesses. In the past such patients often used to phone us with such problems, but this is clearly inappropriate. We welcome greater involvement by GPs in these areas, where their expertise is likely to be considerably greater than ours. It is important to watch carefully for signs of fluid overload (due to inadequate fluid removal on dialysis) which may present as heart failure or breathlessness. We are always pleased to discuss problems over the telephone. If hospital admission is necessary, whether for problems related to renal failure or seemingly unrelated, we very much prefer patients to be admitted to Southmead rather than other hospitals. The reasons for this are to allow us to perform dialysis for patients unable to do so for themselves, and also because many investigations (e.g. angiography, barium enema) require different preparations in patients on dialysis.

### 2. Blood pressure and fluid balance

Many patients may present to GPs with symptoms of fluid imbalance (described above): clinical assessment may be difficult but if an individual GP feels confident in the assessment of fluid imbalance we would welcome involvement by GPs in this area. It should be emphasised that peripheral oedema without distended neck veins should not be taken as a reliable sign of fluid overload, due to the many other causes of peripheral oedema that are present in these patients. Changes in Peritoneal Dialysis regimen should always be discussed with the Unit so that delivery of the correct supplies may be arranged. Hospital assessment may be necessary to differentiate fluid overload from acute cardiac dysfunction, particularly if the patient is at their target weight.

If patients on Peritoneal Dialysis do well, they often gain flesh weight. Attempts to reach the previously set "target weight" may then result in symptomatic hypovolaemia. Target weight may be re set as the weight (on the patients own scales) at which the patient appears euvolaemic:

- No muscle cramps
- No fall in blood pressure from lying to standing
- No peripheral oedema  
(excluding local causes or hypoalbuminaemia)
- No basal crepitations
- JVP not elevated
- Blood pressure no higher than usual

If a GP sees a patient in whom the target weight appears inappropriate he/she should telephone the Unit to discuss this.

### 3. Peritonitis

As mentioned above, Peritoneal Dialysis peritonitis must be investigated immediately in hospital, as delays in treatment or inappropriate therapy may result in irretrievable damage to the peritoneum. However, many patients may first present to GPs with the non-specific symptoms described above, particularly if visually impaired. If possible the dialysate effluent should be inspected. This should be crystal clear, although slightly yellow in colour. If it is even slightly hazy the patient should attend the hospital for investigation. If crystal clear, other causes of abdominal pain such as pancreatitis and peptic ulcer disease should be considered.

### 4. Psychosocial aspects

One of the main disadvantages of the hospital “taking over” the total care of Peritoneal Dialysis patients is the loss of ready access to local supporting services. All patients have access to social worker with a particular interest in renal patients, to a psychologist based in the Renal Unit, and have the opportunity to attend support groups, but this should not preclude active involvement of GPs in the rehabilitation of patients. This should parallel the close collaboration that often already exists between hospital and District nurses.

### 5. Diabetes

Up to 25% of our Peritoneal Dialysis patients are diabetic. We welcome continued involvement by GPs in diabetes care, in particular in monitoring for non-renal complications such as peripheral vascular disease and retinopathy.

6. One of the major complications with the presence of a Tenckhoff catheter within the peritoneum is infection around the site where the catheter exists from the skin, known as the exit site. This is nearly always with skin organisms of which Staph aureus is the most important. The danger with this type of infection is that it might spread down the tunnel that the catheter inhabits into the peritoneum causing severe peritonitis. For this reason, all patients with an exit site infection should be seen on the Peritoneal Dialysis Unit within 24 hours. If patients present to their GPs with signs of an exit site infection a swab should be taken if at all possible, and the patient discussed with the Unit and started on anti-Staphylococcal antibiotics – usually Flucloxacillin. Nasal carriage of Staph aureus is common and predicts subsequent exit site infection. We therefore routinely screen for this with nose swabs and treat carriers with nasal Mupirocin.

### 7. Prescribing

We hope that GPs will continue to issue repeat prescriptions for routine medication. For our part we undertake to communicate clearly and promptly the indications for such therapy and reasons for any changes.

## **PERITONEAL DIALYSIS IN THE COMMUNITY : THE HOME TEAM**

Peritoneal Dialysis patients are trained for home dialysis on an outpatient basis by specialist staff within Southmead Kidney Unit. During their training period they are thoroughly prepared in the techniques necessary to support themselves at home with Peritoneal Dialysis. Although the vast majority of patients are trained to be independent with their treatment their carers and families are encouraged to come along with them and see what is involved with Peritoneal Dialysis.

All patients are supported in the community by their own named Renal Community Nurse. There are 5 members of the Home Dialysis team and 2 home dialysis supplies co-ordinators. The nurses are based at Southmead Hospital in Bristol and are each responsible for a defined geographical area within a 60 mile radius of Bristol.

While attending the hospital for Peritoneal Dialysis training the patients are introduced to their home team nurse. The nurse will arrange to be with them for their first exchange at home and to help them organise their medical supplies. A follow up visit will be arranged for a week or so later to check on the patient's progress. They will then receive regular visits from their nurse, normally every three to four months, or more frequently if necessary.

A member of the home team is available to be contacted by telephone from 8.30 a.m. to 10.30 a.m., Monday to Friday. There is also a telephone answer machine for the periods of time when the Home Team are not available. All the calls are returned as soon as possible. Nursing Staff in the clinical area are always available for advice with any urgent nursing/dialysis related problems.

The provision of dialysis medical supplies are dealt with by the Home Dialysis Co-ordinators. Everything that is required for home dialysis is delivered directly to the patient's home. Everyone at the renal unit is working towards providing a high level of service to support the patient at home. We appreciate that the care given by the GP and community team is of equal importance.