Long-term outcome of continuous ambulatory peritoneal dialysis (CAPD) peritonitis: surgery can be avoided

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ABSTRACT

INTRODUCTION Continuous ambulatory peritoneal dialysis (CAPD) has become the preferred method of home dialysis for patients with end-stage renal failure. Peritonitis is a common and serious complication and requires prompt diagnosis and treatment. The aim of this study was to assess what proportion of patients with CAPD peritonitis that required surgical intervention for on-going sepsis or for peritonitis-related bowel obstruction.

PATIENTS AND METHODS All patients presenting with a first episode of CAPD peritonitis during the 5-year period from 1994–1998 were identified from a prospectively maintained database. Data collected included patient demographics, details of peritonitis episodes and their treatment, and details of any surgical intervention undertaken.

RESULTS A total of 500 episodes were identified in 168 patients of whom 162 had complete follow-up representing 488 peritonitis episodes. Sixty-three patients experienced one episode of peritonitis, 33 two episodes, 20 had three episodes, and 46 had more than three episodes. None of the patients underwent surgery either primarily or for complications of the infective episode. A total of 465 episodes were due to a single organism (95%) and the remainder were due to multiple organisms (5%). The most common causative organisms were Gram-positive cocci (308 episodes; 71%) followed by Gram-negative bacilli (106 episodes; 24%). In 55 patients (34%), the same organism was implicated in consecutive admissions. Patients with autosomal dominant polycystic kidney disease (ADPKD), whilst accounting for 12 of 169 (7%) patients in the cohort, experienced 23 of 125 (18.4%) episodes of peritonitis by Gram-negative cocci. Such infections were seen in 8 of 12 (66.7%) ADPKD patients and accounted for 23 of 40 (57.5%) infections experienced by the ADPKD patients.

CONCLUSIONS Whilst CAPD peritonitis is a common problem in the renal failure population, with almost 100 episodes per year, it would appear that most episodes can be managed using intraperitoneal antibiotics without the need for surgical intervention.

KEYWORDS

Continuous ambulatory peritoneal dialysis – CAPD – Peritonitis

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Since it was first introduced in 1976, continuous ambulatory peritoneal dialysis (CAPD) has become the preferred method of home dialysis for patients with end-stage renal failure.^{1,2} Peritonitis due to exogenous infection is the most significant complication of CAPD and the second commonest cause of mortality in patients undergoing this treatment.³ The incidence of peritonitis has progressively declined, with a reported rate between 0.5–1.4 episodes per patient per year.⁴ This decline has been attributed to improvements in patient education and new connector and catheter technologies.⁵

Patients usually present with a history of draining 'cloudy' peritoneal dialysis fluid and variable accompanying

symptoms of: abdominal pain, nausea and vomiting (30%), diarrhoea (10%), or pyrexia (35–65%).³ The pathogenesis of CAPD peritonitis is different from that of surgical peritonitis. The most common causative organisms are from normal skin flora, mainly coagulase-negative staphylococci, and usually respond well to standard treatment protocols. The possibility of 'surgical peritonitis' should be considered, in cases of recurrent episodes of peritonitis or in those with multiple enteric organisms, and treated promptly in order to decrease morbidity and mortality.^{6,7}

In 1994, a database was set up at the University Hospital of Wales for patients on CAPD presenting with peritonitis. Details of the admission and subsequent episodes were

recorded. The aim of this study was to review these patients and their management at the time of admission and whether any surgical intervention was required during the course of their follow-up.

Patients and Methods

Data collection

Between January 1994 and December 1998, all patients on CAPD admitted with a first episode of peritonitis were identified. Information recorded included: patient demographics; age of patient at first episode of peritonitis; underlying cause of renal failure; date of commencement of CAPD; organism cultured; subsequent episodes of peritonitis during the study period; requirement for surgical intervention.

Treatment protocol

The general advice given to patients when symptoms and signs of peritonitis occur is to attend the peritoneal dialysis unit as soon as possible and bring with them the drained dialysis effluent bag. On arrival, routine observations including temperature, pulse and blood pressure are recorded and a physical examination performed. The peritoneal dialysis effluent is sampled and sent for immediate microscopy including a white cell count as well as culture and sensitivity. Based on a diagnostic white cell count of greater than 100 cells/mm³ with a predominance of neutrophils, empirical antibiotic therapy is commenced. The microscopy result is usually made available within 2 h. Antibiotic regimens vary between units but our protocol over the past 15 years has been intraperitoneal vancomycin (30 mg/kg body weight) and oral ciprofloxacin (500 mg b.d.). Alternatives are chosen if the patient is hypersensitive to either of the above. Therapy is modified once culture and sensitivity results become available. The duration of treatment is usually a total of 2 weeks except in certain specific circumstances when this would be extended to 3 weeks or, sometimes, 4 weeks. If there is slow or non-resolution judged by the rate of clearance of the dialysis bags, then the Tenckhoff catheter is removed and the patient transferred to haemodialysis.

Results

A total of 168 patients were admitted between January 1994 and December 1998 with a diagnosis of CAPD peritonitis. Of these, six were lost to follow-up and 45 remain alive (27%). None of the deaths were attributed to abdominal sepsis or complications thereof. Of the remaining 162 patients, 96 were males and 66 females with a median age of 63 years (range, 20–85 years). The primary cause of renal failure leading to CAPD is summarised in Table 1.

Table 1 Primary renal disease

Disease	Percentage
Hypertension	21
Unknown	19
Glomerulonephritis	14
Diabetes mellitus	13
Autosomal-dominant polycystic kidney disease	7
Systemic disease	6
IgA nephropathy	5
Reflux or obstructive uropathy	5
Pyelonephritis	4
Focal segmental glomerulosclerosis	3
Renal artery stenosis	3

A total of 488 peritonitis episode were reported during the 5-year study period. Sixty-three patients had one episode of peritonitis, 33 two episodes, 20 had three episodes, and 46 had more than three episodes. The distribution of episodes is shown in Figure 1. The median number of episodes per patient for those experiencing CAPD peritonitis was 2 (range, 1–12).

None of the patients in our series underwent surgery either primarily for peritonitis or secondarily for treatment of underlying gastrointestinal complications or complications of peritonitis such as adhesional obstruction.

Of the 488 episodes of peritonitis, 465 were due to a single organism (95%) and the remainder were due to multiple organisms (5%). The most common causative organisms

Figure 1 Number of episodes of CAPD peritonitis experienced by the 162 patients.

Table 2 Organisms cultured from dialysis fluid of patients with CAPD peritonitis

Organism	Number of episodes
Gram-positive cocci	
Staphylococci	254
<i>Staphylococcus aureus</i>	69
<i>Staphylococcus epidermidis</i>	185
Streptococci	49
Alpha haemolytic streptococci	12
Non-haemolytic streptococci/enterococci	19
Type not specified	18
Unclassified Gram-positive cocci	5
Gram-negative bacilli	
Mixed anaerobes	81
<i>Pseudomonas aeruginosa</i>	13
<i>Klebsiella pneumoniae</i>	5
<i>Escherichia coli</i>	3
<i>Acinetobacter baumannii</i>	4
Gram-positive rods	
<i>Corynebacterium</i> spp.	13
Gram-negative cocci	
<i>Neisseria meningitidis</i>	4
Yeast	
<i>Candida albicans</i>	16
Others	18

were Gram-positive cocci (308 episodes, 71%) followed by Gram-negative bacilli (106 episodes, 24%; Table 2).

An analysis of type of organism causing peritonitis versus the cause of renal failure identified autosomal dominant polycystic disease (ADPKD) to be associated with infection with enteric organisms. Patients with ADPKD represented 12 of 169 (7%) patients and they experienced 40 of 488 (8%) episodes of peritonitis. Of the 125 episodes of infection by typically enteric organisms, 23 of 125 (18.4%) were seen in patients with ADPKD; of the 40 episodes of CAPD peritonitis experienced by this group, 23 (57.5%) were due to Gram-negative bacilli. Eight of the 12 patients with ADPKD had enteric organisms identified on one or more occasions.

Of the 99 patients experiencing more than one episode of peritonitis, in 55 patients (55.6%) the same organism was implicated in consecutive admissions. Several of these patients experienced more than one episode of consecutive infection during the duration of the study in which different organisms were isolated; therefore, a total of 63 consecutive infection episodes were seen in 55 patients. Table 3 summarises the organisms involved in these recurrent

Table 3 Organisms implicated in multiple admissions with CAPD peritonitis

Organism	Number of patients	Number of relapses	
		Range	Median
Gram-positive cocci			
<i>Staphylococcus aureus</i>	13	2–7	3
<i>Staphylococcus epidermidis</i>	32	2–8	2
Gram-negative bacilli			
<i>Pseudomonas aeruginosa</i>	14	2–9	2
Gram-positive rods			
<i>Corynebacterium</i> spp.	4	2–3	2

admissions. The commonest organisms responsible such infections were *Staphylococcus* spp. and *Pseudomonas* spp. The consecutive infection intervals were divided into 2–4 weeks (24 of 63 patients; 38%) from primary event to secondary event, and > 4 weeks (39 of 63 patients; 62%) between primary and secondary infection, with the former being classed as relapses and the latter as re-infections.

Discussion

The most important finding from this study was that patients developing CAPD peritonitis could be managed conservatively using intraperitoneal antibiotics; although some patients developed repeated infections, surgical intervention was not required either primarily or for secondary complications of peritonitis. CAPD peritonitis is a major problem for patients choosing this form of renal replacement therapy as it accounts for 6–29% of drop-outs from programmes, 7% of deaths and 23–68% of hospital admissions.^{6,8,9}

The most common causative organisms reported in the literature are *Staphylococcus epidermidis* accounting for 18.8% of peritonitis episodes followed by *Staphylococcus aureus* (18.6%).¹⁰ Less common organisms reported include *Streptococcus* spp. (5%), *Pseudomonas* spp. (5%), *Enterobacteria* spp. (6%) and fungal infections (3%).^{8,11} In our series, *S. epidermidis* was also the most common causative organism accounting for 38% of cases, followed by *S. aureus* (14%). *Streptococcus* spp. accounted for 10% of cases and the incidence of fungal peritonitis was similar to that reported in the literature with an incidence of 3%.

It is often a diagnostic challenge to differentiate those patients with CAPD-associated infections from those who have unrelated gastrointestinal pathology as the cause of peritonitis and would benefit from surgical exploration. A number of studies in the past have been carried out in order

to identify accurate indicators to differentiate between these two patient groups.

Polymicrobial peritonitis is a serious complication with an overall reported incidence of 6–9%.^{12–15} Its cause and optimal management remain controversial and has been proposed as a reliable indicator of underlying gastrointestinal disease. The International Society of Peritoneal Dialysis published guidelines in 2000, based on results of published studies, in which it recommends that, in cases of multiple Gram-negative organisms, the possibility of intra-abdominal pathology should be considered with early surgical exploration.⁵

Spence *et al.*⁷ studied 78 episodes of peritonitis over a 27-month period. They found that the only reliable indicator was of multiple enteric organisms cultured from patients with persistent abdominal pain and laparotomy always revealed significant abdominal pathology.⁷ Carmeci *et al.*¹³ performed a retrospective study of patients with CAPD peritonitis between 1990 and 1998. Six patients underwent laparotomy when cultures revealed multiple enteric organisms. All the patients underwent a CT scan of the abdomen and pelvis prior to surgery. Mortality was 16%, one laparotomy was negative and CT scan was non-diagnostic in all cases.¹³ Other studies have demonstrated similar findings.^{1,6,16}

There is recent evidence to suggest that current antibiotic therapy may be a safe alternative to surgery in cases of polymicrobial peritonitis. Kim and Korbet¹⁵ reported that only 7% of cases had an intra-abdominal process going on and the majority of patients were treated successfully without any surgical intervention. These findings have been reflected in a number of other studies.^{12,17,18} In our series, 23 peritonitis episodes were due to multiple organisms; all were treated successfully with antibiotics without surgical intervention.

The high prevalence of infection with enteric organisms in patients with ADPKD is noteworthy. The characteristic features of a kidney affected by ADPKD are large numbers of epithelial lined-cysts arising from both the nephrons and collecting ducts; in addition, there are a number of well-recognised extra-renal associations such as hepatic and pancreatic cysts, colonic diverticulae, cardiac valvular anomalies and intracranial aneurysms.¹⁹ The link between diverticular disease and ADPKD is believed to be related to an abnormality in polycystin expressed in smooth muscle leading to impaired smooth muscle contractility due to alterations in calcium homeostasis.

In relation to the question of re-infection or relapse when peritonitis occurred for a second occasion with the same implicated organism, Al-Wali and colleagues²¹ noted a worse prognosis for patients with relapse as this group had greater antibiotic resistance and a higher requirement for catheter removal. The definition of relapse adopted by Al-Wali was of two or more episodes in 1 year with the same

organism whereas the current paper defined relapse as re-infection within 1 month. In addition, they define a re-infection as occurring more than 1 year later with any organism, whereas we looked at re-infection in terms of the same organism > 1 month after the primary episode. In this series, a second infection with a different organism to the index infection was regarded as a completely independent event. The majority of the re-infections were due to the two commonest organisms; therefore, it is difficult to be certain about the distinction between re-infection and relapse in many patients. As these are common skin commensals, it is likely that they caused infection through poor aseptic technique.

These findings of successful, non-operative management of peritonitis may have implications for general surgical patients with evidence of peritonitis but no gross contamination, especially those with significant co-morbidities in whom a laparotomy would be very high risk. The current results of surgical management of peritonitis secondary to colonic perforation are poor with a mortality rate of 30–35% and a high morbidity of between 35–55% depending upon the surgical procedure performed; any means of improving these results would be welcomed. It may be that a proportion of these patients without gross contamination could be managed minimally-invasively through laparoscopy, washout and insertion of a CAPD catheter for irrigation and administration of intraperitoneal antibiotics.

Conclusions

The study has shown that patients with CAPD peritonitis can be managed non-operatively using intraperitoneal antibiotics without the need for surgical intervention. However, should the patient have persisting symptoms or signs that indicated an underlying gastrointestinal problem, or should there be evidence on radiological imaging of such a process, then referral and surgical assessment would be mandatory.

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