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Peritonitis in continuous ambulatory peritoneal dialysis in children living in Saudi Arabia

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Abstract. The clinical aspects of peritonitis and catheter infections were reviewed in 64 children on continuous ambulatory peritoneal dialysis living in Saudi Arabia over a period of 6 years. Peritonitis occurred in 41 children (64%). The mean time from starting dialysis to the first episode of peritonitis was 7.2 months. The incidence of peritonitis was 1 episode in 9 treatment months. Gram-negative organisms were responsible for the majority of episodes (42%), followed by Gram-positive organisms (20%), and *Candida albicans* (6%); 32% were culture negative. Recurrent peritonitis was present in 20 cases. Catheter was replaced in 24 patients: 44% due to recurrent peritonitis. Peritoneal membrane loss occurred in 7 patients, 3 had *Candida* peritonitis and 3 had recurrent peritonitis due to *Pseudomonas*. The mortality rate was 4.6% but none of the deaths were related to peritonitis or dialysis.

Key words: Peritonitis – Continuous ambulatory peritoneal dialysis – Saudi Arabia

Introduction

Catheter-related infections and peritonitis remain the most significant complications of continuous ambulatory peritoneal dialysis (CAPD) [1]. In Europe and North America several centers have published their experience with peritonitis as a complication of CAPD in a pediatric population, however, from the Arab region there are no detailed published reports. We have studied over the past 6 years 64 children living in Saudi Arabia with a diagnosis of end-stage renal disease (ESRD) and receiving CAPD, to determine the epidemiological and clinical features and etiology of peritonitis and other catheter-related infections.

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Patients and methods

Between June 1987 and August 1993, 64 children with a diagnosis of ESRD and CAPD were studied at our hospital in Riyadh, Saudi Arabia. The CAPD procedure was performed as described by Oreopoulous et al. [2]. Each patient received four to five daily exchanges with a dialysate (Fresenius) of 250 ml–1,000 ml per exchange (dialysate volume range 30–50 ml/kg). Only straight double-cuffed Tenchkoff catheters were used. The CAPD training lasted 3 weeks. Age, sex, peritonitis rates, exit site infections, etiological organisms, and patient outcomes were analyzed.

Definitions

Peritonitis. Our criteria for the diagnosis of peritonitis were: (1) cloudy dialysate with abdominal pain and tenderness, (2) white blood cells in dialysate effluent >100 cells/mm^3 with a differential count of $>50\%$ polymorphonuclear cells. A positive Gram stain or culture was not a requirement for diagnosis; however, these data were always obtained and evaluated.
Recurrent peritonitis was defined as the presence of the same organism within 2 weeks of stopping antibiotic therapy.
Persistent peritonitis was defined as the persistence of positive dialysate cultures with the same organisms despite appropriate antibiotic treatment.
Exit site infections were defined as purulent drainage and/or erythema of the skin at the catheter exit site.
Tunnel infection was defined as erythema and/or swelling and tenderness over the subcutaneous catheter tunnel, extending more than 1 cm from the exit site.

Treatment of peritonitis

Initially, all patients were placed on vancomycin (30 mg/l) and tobramycin (8 mg/l) intraperitoneally (i.p.) after receiving an intravenous (i.v.) loading dose, vancomycin (15 mg/kg), tobramycin (1.7 mg/kg). In the last 3 years tobramycin was replaced by ceftazidime (125 mg/l) after an i.v. loading dose. Heparin 500 unit/l was added to the

dialysate for the first 24–48 h to inhibit fibrin formation. All children remained on the initial i.p. antibiotic therapy until sensitivities were known, and then were given the most appropriate antibiotic i.p. to complete a 10- to 14-day treatment course. Repeated cultures were taken at day 5 and 10, and if culture on day 10 was negative therapy was discontinued in 48 h. In *Pseudomonas* peritonitis two antibiotics with activity against *Pseudomonas* were used for 3 weeks. Fungal peritoniitis was managed by immediate catheter removal [3, 4].

Treatment of exit site infections

No topical antibiotics were used. Infections were managed by either oral or i.v. antibiotics for a duration of 10 days [4]. Indication for catheter removal included: (1) fungal peritonitis, (2) recurent or persistent peritonitis, and (3) tunnel infection.

Statistical analysis

Statistical analyses were performed using life-table analyses, Student's *t*-test, and chi-squared where applicable [5].

Results

Incidence of peritonitis

Of 64 patients who received CAPD treatment during the 6-year period, 41 (64%) developed peritonitis. There were 120 episodes of peritonitis occurring in 1,080 patient treatment months, giving an incidence of 1 episode every 9 patient treatment months. The mean first episode occurred after 7.2 months.

Demographic characteristics

The mean age of the patients who developed peritonitis was 6.5 years (range 5 months to 12.5 years); 56% were older than 6 years of age and only 9% were younger than 2 years. The ratio of girls to boys was 25:16; no significant difference was seen in the incidence of peritonitis and exit site infection between the two sexes. The mortality rate was 4.6%, but none of the deaths were related to peritonitis or dialysis.

Clinical features

Cloudy dialysate was present in all episodes, abdominal pain was present in 63% of episodes, and fever in 17%.

Bacteriology

Of all the episodes of peritonitis, 42% were caused by Gram-negative bacteria, 20% by Gram-positive bacteria, 6% by *Candida albicans*, and 32% were culture negative. *Pseudomonas aeruginosa*, *Klebsiella* species, *Escherichia coli*, and *Serratia marcescens* were the predominant Gram-negative organisms, whereas *Staphylococcus aureus* and *Staphylococcus epididermis* were the predominant Gram-positive organisms (Table 1).

Table 1. Etiology of peritonitis

Organism	Number of episodes of peritonitis (*n*)	Percentage (%)
Culture-negative	39	32
Fungi	7	6
Gram-positive	24	20
Staph. aureus	16	
Staph. epidermidis	5	
Streptococci group D	1	
Hemoloytic streptococcus	2	
Gram-negative	50	42
Pseudomonas	25	
Klebsiella	10	
Serratia	5	
E. coli	5	
Enterobacter	1	
Acinetobacter	1	
Proteus	1	
Mixed	2	
Total	120	100%

Exit site and tunnel infections. A total of 30 episodes of exit site infections were observed; 15 episodes were caused by *Staph. aureus* and 14 by *Pseudomonas aeruginosa*. Only 3 tunnel infections were observed: 2 were caused by *Staph. aureus* and 1 by *Pseudomonas aeruginosa*.

Fungal peritonitis. All 7 episodes of fungal peritonitis were caused by *Candida albicans*. They were managed by prompt catheter removal followed by oral KetoKanazole for 2 weeks. Peritoneal membrane loss occurred in 3 patients with *Candida* peritonitis, the other 4 were temporarily placed on hemodialysis for 4 weeks, and thereafter CAPD was resumed satisfactorily.

Recurrent peritonitis and persistent peritonitis. Recurrent peritonitis was observed in 20 cases; *Pseudomonas aeruginosa* was the predominant cause (10 patients) followed by *Staph. aureus* (5 patients) (3 patients were nasal carriers of *Staph. aureus*), *Klebsiella pneumonia* (3 patients), and *E. coli* (1 patient). No relationship with sex or age was noticed. A total of 11 catheters were changed; in 7 *Pseudomonas aeruginosa* was the organism; in 2 the organisms were *Staph. aureus* and in 1 catheter each the organisms were *E. coli* and *Klebsiella pneumonia*. Three cases of persistent peritonitis were observed. In 2 patients the causative organism was *Pseudomonas aeruginosa* and in 1 the organism was *Klebsiella pneumonia*.

Catheter removal and membrane loss. Catheter removal was required in 24 patients; 11 had recurrent peritonitis, 7 had fungal peritonitis, 3 had tunnel infections, and 3 had persistent peritonitis. Peritoneal membrane loss occurred in 7 patients; 3 had *Candida* peritonitis, 3 had recurrent

peritonitis caused by *Pseudomonas aeruginosa*, and 1 had persistent peritonitis caused by *Pseudomonas aeruginosa*. All patients had a loss of ultrafiltration and were placed on hemodialysis.

Discussion

Our experience with 64 pediatric patients living in Saudi Arabia and receiving CAPD over a period of 6 years revealed an incidence of 1 episode of peritonitis in 9 patient treatment months. Earlier reports [6] demonstrated a higher incidence of 1 episode every 4.6 patient treatment months. Recent data from the North American Pediatric Renal Transplant Cooperative Study (NAPRTCS) demonstrated an incidence of 1 episode in 13.3 patient treatment months [7] and the Italian Registry demonstrated 1 episode in 16.2 patient treatment months [8].

A literature review revealed that Gram-positive bacteria are a more frequent cause of CAPD peritonitis than Gram-negative bacteria [9,10]. The high incidence of Gram-negative infection (42%) observed by us could not be attributed to any definite factor. However, similar results have been reported by Warady et al. [11]. This high incidence was due to 2 patients with nephrostomies who were alone responsible for the 37% incidence of the Gram-negative peritonitis. Failure to isolate the organisms was seen in 32% of episodes. Isolation of the organisms depends upon culture techniques, concentration of the dialysate effluent, and lag times between obtaining and culturing peritoneal fluid. A similar high incidence of culture-negative peritonitis was observed in previous studies [6, 9]. We observed a high rate of recurrent peritonitis (20 patients). Chronic exit infections with the same organism were seen in 70% of the cases of recurrent peritonitis and nasal carriers of *Staph. aureus* were found in 15% of cases. Our findings are consistent with previous reports [12, 13] that persistent catheter-related infection is associated with recurrent peritonitis. A slightly high incidence of *Candida* peritonitis (6%) was observed in our study compared with other reports [6, 9]. Peritoneal membrane loss should be prevented and minimized. We believe that prompt catheter removal rather than a trial of antifungals could reduce this complication. A low mortality of 4.6% is comparable to recent data of NAPRTCS (5.6%) [7]. We conclude that future study of CAPD peritonitis should investigate predisposing factors, immune status, safe and potent vaccines, and CAPD sets.

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