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Peritoneal dialysis-associated peritonitis: clinical features and predictors of outcome

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ABSTRACT

Objectives: The objective of this study was to identify the epidemiological, clinical, and microbiological factors affecting the outcome of peritoneal dialysis (PD)-associated peritonitis.
Methods: All patients with PD-associated peritonitis, cared for at the University Hospital of Heraklion from 1990 to 2007, were retrospectively studied.
Results: A total of 247 episodes of PD-associated peritonitis occurring in 82 patients were evaluated. The median age of patients was 68 years (range 10–92 years); 51 (62%) were males. There were 104 episodes (42%) of Gram-positive peritonitis, 46 (19%) of Gram-negative peritonitis, 13 (5%) of polymicrobial peritonitis, and 11 (4%) of fungal peritonitis. There were 64 (26%) complicated episodes. The latter included 22 (8.9%) relapses, 13 (5.3%) repeated episodes, 18 (7.3%) catheter removals, and 11 (4.5%) deaths. In multivariate analysis, the presence of a purulent exit-site infection ($p < 0.001$), peritoneal dialysis effluent cell count $>100 \times 10^6$/l for more than 5 days ($p < 0.001$), use of antimicrobials during the preceding 3 months ($p < 0.05$), and low serum total protein level on admission ($p < 0.05$) were independent predictors of a complicated course.
Conclusions: Exit-site infection, more than 5 days with a peritoneal dialysis effluent cell count $>100 \times 10^6$/l, prior use of antimicrobials, and low serum total protein level are potential predictors of complicated PD-associated peritonitis and may distinguish high-risk cases.

1. Introduction

Peritoneal dialysis (PD) is an important form of renal replacement therapy for patients with end-stage renal disease (ESRD). The percentage of ESRD patients maintained on chronic PD is declining, due to the high incidence of peritonitis, which represents a frequent complication and the main cause of peritoneal catheter loss and termination of continuous ambulatory peritoneal dialysis (CAPD).[1] Usually after such an infection patients are managed by hemodialysis.[2–4]

The identification of risk factors, publication of guidelines, development of new techniques, and the implementation of more effective therapies have led to a reduction in the PD-associated peritonitis incidence.[5–7] However, this infection remains a significant cause of morbidity and mortality in patients undergoing PD.[8,9] There have been few studies investigating risk factors that could predict the outcome of this infection once it develops.[10]

The aim of this study was to identify epidemiological, clinical, and microbiological factors affecting the severity and outcome of PD-associated peritonitis.

2. Methods

This study was performed at the 650-bed University Hospital of Heraklion, Crete, Greece. The records of all patients hospitalized with PD-associated peritonitis between January 1990 and June 2007 were retrospectively reviewed.

The diagnosis was based on established criteria.[8] Peritonitis was defined by the presence of cloudy PD effluent with more than 100×10^6 white blood cells (WBC)/l and a WBC differential of more than 50% polymorphonuclear cells.[5] Because the definition of PD-associated peritonitis varied slightly during the long period of our study, we considered eligible only patients who fulfilled the above definition, irrespective of the time of diagnosis.

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The data extracted from the medical records included: demographic characteristics such as age at time of peritonitis, age at start of PD, sex, and cause of ESRD; underlying medical conditions; type of PD (CAPD/ambulatory peritoneal dialysis (APD)) and duration of PD therapy; data for each PD-associated peritonitis episode, including symptom duration, number of episodes, use of antimicrobials during the three preceding months (we were able to retrieve this information since all patients suffered from a chronic condition and were under continual and intensive observation), time interval between two episodes, presence of exit-site infection (erythema or drainage from the exit-site or both), causative organisms, type and duration of treatment, and length of hospital stay; laboratory examinations for each episode on admission, including WBC count, C-reactive protein (CRP), serum erythrocyte sedimentation rate (ESR), serum albumin and total serum protein levels, and WBC count in peritoneal dialysate; and outcome.

Regarding the peritonitis course, patients were divided into two groups: those with curable and those with complicated episodes. An episode was considered curable if resolution occurred with antimicrobial therapy, without catheter removal. An episode was considered complicated if there was relapse or the episode was repeated, if removal of the catheter took place and/or there was need for temporary or permanent hemodialysis, and, of course, if the outcome was fatal. Death was considered peritonitis-associated if due to sepsis, if it occurred at the time of a positive peritoneal dialysis fluid culture, or if it occurred during the hospitalization period for any patient admitted with peritonitis or happened within one month following the onset of the infection.[5] Episodes due to the same organism with the same sensitivity pattern occurring during the 4-week period after completion of antimicrobial therapy were defined as relapses.[5] An episode was considered repeated if due to the same organism with the same sensitivity pattern, but occurred after the 4-week period following the completion of therapy.[5]

Peritonitis was treated intraperitoneally. Initial empiric treatment consisted of vancomycin with an aminoglycoside or, alternatively, ceftazidime. The dosages used were as per standard guidelines.[8] Subsequent therapy depended on cultures and sensitivities.

2.1. Statistical analysis

Univariate analyses were first conducted to identify potential risk factors for complicated episodes. The association between two categorical variables was evaluated by Chi-square test or Fisher's exact test as appropriate. For continuous variables, the Student's *t*-test (for normally distributed variables) or the non-parametric Mann–Whitney test was used to compare the difference in mean values in the two groups. Variables showing a statistically significant association with complicated course, with a *p*-value of <0.05, were considered candidate variables for inclusion in the multivariate model in order to determine which variables were independent predictors of a complicated outcome. Stepwise multivariate logistic regression was performed including the potential candidate variables.

All analyses were conducted using SPSS version 13.0 (SPSS Inc., Chicago, IL, USA). All statistical tests performed were two-tailed; $p < 0.05$ was considered as statistically significant.

3. Results

During the 17.5-year study period, 247 episodes of PD-associated peritonitis were identified in 82 patients. The overall peritonitis rate was one episode per 14 patient-months or 0.89 episodes per patient-year.

The median age of patients was 68 years (range 10–92 years). There were 51 males (62%) and 31 females (38%). Seventy-four (90%) had an underlying disease, with the most frequent being diabetic nephropathy (23 patients; 28%). Fifty-one patients (62%) were on APD, while 31 (38%) were on CAPD. The median duration of peritoneal dialysis for all patients was 14 months (range 1–217 months). Demographics are shown in Table 1.

Gram-positive organisms were responsible for 104 episodes (42%), Gram-negative for 46 (19%), and fungi for 11 (4%). In 13 episodes (5%), peritonitis was polymicrobial, while in 73 (30%) cultures were negative. The causative organisms are listed in Table 2.

Staphylococcus epidermidis and *Staphylococcus aureus* were the most common Gram-positive organisms, isolated in 48 (46%) and 20 (19%) cases, respectively, while *Escherichia coli* was the most common Gram-negative organism and was identified in eight cases (17%).

One hundred eighty-three episodes (74%) were cured with the initial antimicrobial regimen. Sixty-four episodes (26%) were considered complicated and included 22 (8.9%) relapses, 13 (5.3%) repeated episodes, 18 (7.3%) catheter removals with temporary or permanent transfer to hemodialysis, and 11 (4.5%) deaths. The types of episode and the outcome of all cases are summarized in Table 3, while the characteristics of the 11 patients with a fatal outcome are shown in Table 4.

In the univariate analysis, episodes in which antimicrobial treatment was received at some point in time during the three preceding months were significantly associated with a complicated course, as compared to episodes without prior treatment (45% vs. 24%; $p = 0.001$). Furthermore, episodes where there was an exit-site infection were significantly associated with a complicated course when compared to episodes without this type of infection

Table 1
Patient demographic and clinical data

Characteristics	
Sex: male/female, *n*	51/31
Community: urban/rural, *n*	39/43
Age (years), mean ± SD	64.1 ± 16.2
Duration on dialysis (months), mean ± SD	21.5 ± 23.6
Co-morbidities, *n* (%)	
Hypertension	48 (59)
Cardiovascular disease	45 (55)
Diabetes mellitus	26 (32)
Secondary hyperparathyroidism	16 (20)
Obstructive pulmonary disease	7 (9)
Autoimmune disease	6 (7)
Cancer	2 (2)
Causes of ESRD, *n* (%)	
Diabetic nephropathy	23 (28)
Hypertensive nephrosclerosis	13 (16)
Glomerulonephritis	8 (10)
Polycystic kidney disease	7 (9)
Chronic pyelonephritis	5 (6)
Obstructive uropathy	5 (6)
Unknown	18 (22)
Other	3 (4)
Type of peritoneal dialysis, *n* (%)	
Continuous ambulatory	31 (38)
Ambulatory	51 (62)
No of peritonitis episodes, *n* (%)	
1	30 (37)
2	18 (22)
3–4	16 (19)
>5	18 (22)
Previous history of peritonitis, *n* (%)	
Yes	31 (38)
No	51 (62)

ESRD, end-stage renal disease.