

Spectrum of Organisms Causing Peritonitis in Peritoneal Dialysis Patients—Experience from Bangladesh

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In the present study, organisms responsible for peritonitis and their sensitivity to antibiotics were evaluated in peritoneal dialysis (PD) patients in Bangladesh.

We collected PD effluent from 100 peritonitis cases and sent samples to the laboratory for Gram stain and cytology. Cultures used direct inoculation of PD fluid in plate media and broth media simultaneously.

Organisms were isolated by Gram stain in 60% of cases. Cell counts showed a mean of 700 (range: 90 – 7000) white blood cells per milliliter. Plate media yielded 33% growth, and broth media, 67% growth. In continuous ambulatory PD, 77% samples were culture-positive; the organisms isolated were gram-positive bacteria in 41% of cases, gram-negative bacteria in 52%, and fungus in 7%. In intermittent PD, only 43% samples were culture-positive; the isolated organisms were gram-positive bacteria in 18% cases and gram negative bacteria in 82%. Gram-positive organisms (Staphylococcus and Streptococcus species) were sensitive to vancomycin and rifampicin; moderately sensitive to ciprofloxacin, ceftriaxone, and ceftazidime; and resistant to ampicillin, cloxacillin, and cephalixin. Gram-negative organisms (Escherichia coli, Klebsiella species) were sensitive to imipenem and aztreonam, and moderately sensitive to ciprofloxacin, ceftriaxone, ceftazidime, and gentamicin. Pseudomonas species were sensitive to aztreonam and ceftazidime, and moderately sensitive to ciprofloxacin, ceftriaxone, and gentamicin.

Gram-negative organisms were predominantly responsible for peritonitis in PD patients, and before culture results are received, combined empiric therapy with vancomycin and imipenem or aztreonam may be started.

Key words

Continuous ambulatory peritoneal dialysis, intermittent peritoneal dialysis, peritonitis, organisms, sensitivity

Introduction

Continuous ambulatory peritoneal dialysis (CAPD) has been improving since the inception of the modality. The improvements started with changes to the plastic bags and catheter design, with better connection techniques such as the “flush before fill” system, and with the introduction of automated PD (1,2). The rate of peritonitis has fallen from 4 – 5 episodes annually to nearly 1 episode every 2 years (3). Since the introduction of the twin-bag system, some centers have reported that the incidence of infection among its users has fallen to 0.4%, with a significant increase in the infection-free period as compared with that in non users of the twin bag (4). Even then, peritonitis is still the most frequent complication in many PD patients, leading to considerable morbidity and mortality, with frequent modality changes. At the same time, the types of organisms causing peritonitis and the susceptibility of those organism to antibiotics have also been changing (5).

In the present study, organisms responsible for peritonitis and their sensitivity to antibiotics were evaluated in PD patients in Bangladesh.

Patients and methods

Our study included effluents from a total of 100 PD peritonitis cases for which data for all parameters could

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be gathered. The effluents were collected from suspected peritonitis cases in the department of nephrology, BSM Medical University, Bangladesh, during the period 1998 – 2002. Of the 100 effluent samples, 60 were from CAPD patients and 40 were from intermittent PD (IPD) patients. All study subjects were adults from a predominantly diabetic population.

In CAPD patients, a Tenckhoff double-cuffed straight catheter was surgically implanted. Connection systems were straight or Y connection (predominantly spike). In IPD patients, dialysis was performed with single-use rigid peritoneal catheters. All patients were evaluated for relevant clinical and biochemical parameters.

Peritonitis was diagnosed by the presence of cloudy dialysate and of more than 100 white cells/mm³ (more than 50% neutrophils) by microscopy of PD effluent, with constitutional symptoms. In CAPD cases, the infected PD bag, and in IPD cases, 200 mL dialysate in a sterile container, was sent to the laboratory for Gram stain and cytology. In the microbiology department, effluent cultures used direct inoculation of PD fluid into plate media (MacConkey, blood agar) and broth (trypticase soy) media simultaneously. Drug sensitivity was tested using a number of pre-selected antibiogram discs.

Results

Gram stain of PD fluids isolated organisms in 60% of the specimens. For positive cultures, the sensitivity was 83%, and the specificity, 60%. Cell counts showed a mean of 700 (range: 90 – 7000) white blood cells per milliliter. Differential counts showed that polymorphs in 75% of specimens. For positive cultures, the sensitivity was 96%, and the specificity, 54%.

Cultures yielded positive growth in 77% of CAPD and 57% of IPD samples. Growth of organisms was positive in 33% of plate media and 74% of broth media. In CAPD, the organisms isolated were gram-positive bacteria in 41% of cases, gram-negative bacteria in 52%, and fungus in 7% (Table I). In IPD, only 43% of samples were culture-positive; the organisms isolated were gram-positive bacteria in 18% of cases and gram negative bacteria in 82% (Table II).

Drug sensitivity testing showed that gram-positive organisms (*Staphylococcus aureus* and *S. epidermidis*, *Streptococcus* species) were sensitive to vancomycin and rifampicin; moderately sensitive to ciprofloxacin, ceftriaxone, and ceftazidime; and resistant to ampicillin,

TABLE I Infecting organisms in continuous ambulatory peritoneal dialysis peritonitis

Organism	(%)
Gram-negative	52
<i>Escherichia coli</i>	30
<i>Pseudomonas</i> species	7
Others	15
Gram-positive	41
<i>Staphylococcus epidermidis</i>	26
<i>Staphylococcus aureus</i>	11
<i>Streptococcus</i> species	4
Fungus	7

TABLE II Infecting organisms in intermittent peritoneal dialysis peritonitis

Organism	(%)
Gram-negative	82
<i>Escherichia coli</i>	58
<i>Pseudomonas</i> species	12
Others	12
Gram-positive	18
<i>Staphylococcus epidermidis</i>	10
<i>Staphylococcus aureus</i>	2
<i>Streptococcus</i> species	6

cloxacillin, and cephalexin (Table III). Gram-negative organisms (*Escherichia coli*, *Klebsiella* species) were sensitive to imipenem and aztreonam, and moderately sensitive to ciprofloxacin, ceftriaxone, ceftazidime, and gentamicin. *Pseudomonas* species were sensitive to aztreonam and ceftazidime, and moderately sensitive to ciprofloxacin, ceftriaxone, and gentamicin (Table IV). Sensitivity to ampicillin, cloxacillin, and cephradine was remarkably low for gram-positive organisms. Similarly, low sensitivity for ciprofloxacin and ceftriaxone was seen for most gram-negative microbes.

Discussion

Peritonitis incidence and the spectrum of organisms (with their sensitivity to antibiotics) have been changing since the late 1990s. Better care of the catheter and the exit site has reduced the incidence of both *S. aureus* and *S. epidermidis* (6). A study by Piraino *et al.* (7) showed that the incidence of coagulase-negative *Staphylococcus* has declined since the late 1990s, but that the proportion of peritonitis cases attributable to gram-negative organisms has increased. A similar finding was reported in another study (8) in which the

TABLE III Drug sensitivity of gram-positive organisms

Drug	Sensitivity (%)		
	Staphylococcus aureus	epidermidis	Streptococcus species
Ampicillin	R	R	R
Cloxacillin	20	R	R
Cephadrine	20	R	R
Ceftazidime	20	20	R
Vancomycin	100	100	100
Rifampicin	100	100	100

R = resistant.

TABLE IV Drug sensitivity of gram-negative organisms

Drug	Sensitivity (%)		
	Escherichia coli	Pseudomonas species	Klebsiella species
Ceftazidime	75	100	65
Ciprofloxacin	35	45	35
Ceftriaxone	50	70	65
Gentamicin	35	45	100
Aztreonam	55	100	100
Imipenem	100	100	100

incidence of peritonitis decreased to less than half, mainly because of a decrease in *S. epidermidis*; at the same time, infection with gram-negative organisms increased. A similar trend of selective decrease in gram-positive peritonitis with a proportional rise in infections with gram-negative organisms has also been reported in a long-term pediatric PD population (9). These changes are thought to be secondary to improved connectology, decreased touch contamination because of the twin-bag system and “flush before fill” technique, and the use of prophylactic and local antibiotics.

In our study, gram-negative organisms were dominant. Predisposing causes for gram-negative infections include the use of spike disconnect systems; presence of diabetes; presence of gastroenteritis, urinary tract infection, or intra-abdominal pathology; and prior antibiotic use or prophylaxis (9,10). Many of our patients had diabetes, and they often used spike disconnect systems (most of the CAPD patients, and all of the IPD patients), factors that might contribute to a higher incidence of gram-negative infection.

Geographic variations also influence infection rates and patterns at different centers. A more hot and humid climate—such as that in Bangladesh—favors more

frequent infections with both gram-positive and gram-negative organisms (3). A similar higher incidence of Enterobacteriaceae has been reported in other studies from the Indian subcontinent (11,12). Prasad *et al.* (11) observed that these organisms are mostly fecal in origin, and infections are probably attributable to the population’s unique post-defecation washing habits.

Drug sensitivity tests in our study showed that both groups of organisms (Tables III and IV) were poorly sensitive to the more common antibiotics. Cephalosporins were ineffective for *Staphylococcus* and *Streptococcus* species, which were sensitive only to vancomycin and rifampicin. On the other hand, quinolones and aminoglycosides were less effective against gram-negative organisms.

The susceptibility patterns of antimicrobials differ widely from center to center. Sensitivity of gram-negative organisms to ciprofloxacin was 35%–45% in our study, similar to that in the study of Keithi-Reddy *et al.* (12), but around 90% in a study by Zelenitsky *et al.* (13). Similarly, 45%–65% of gram-negative organisms were resistant to gentamicin in the former two studies, but 24% were resistant in the latter. Gram-negative organisms had a better than 60% sensitivity to third-generation cephalosporins in our study, but showed similar percentage of resistance in others.

Conclusions

It is evident from various studies and registry reports that the spectrum of organisms responsible for peritonitis in PD patients and the sensitivity patterns of those organisms toward antimicrobials vary significantly from center to center even within similar geographic and socio-economic conditions. The International Society for Peritoneal Dialysis recommends center-specific selection of empiric therapy depending on the history of sensitivities of the organisms causing peritonitis.

The present study showed that, in our center, gram-negative organisms are predominantly responsible for peritonitis in PD patients and that, before culture results become available, empiric combined therapy with vancomycin and imipenem or aztreonam may be started, because those drugs will cover the preponderance of infecting organisms.

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