Renal Disease and Transplantation Forum
2024, vol. 17, no. 4, 136–141

ISSN 2720–2771
e-ISSN: 2720-4189
DOI: 10.5603/rdatf.102604

VIA MEDICA

Szymon Drągowski, Joanna Szczykowska-Miller, Ewa Suchowierska, Beata Naumnik

1st Department of Nephrology, Transplantation and Internal Medicine with the Dialysis Centre Medical University of Bialystok, Poland

Tenckhoff catheter exit site and tunnel infections – guidelines vs. clinical practice

Abstract

The basic condition for starting and conducting peritoneal dialysis is a well-functioning Tenckhoff catheter. Two types of catheter-related infections are exit site and tunnel inflammation. Due to new guidelines for treating catheter-related infections, we have analysed the collected cultures in our unit (in 2019-2023). We evaluated them for pathogen specificity and sensitivity to cephalosporins and ciprofloxacin. Results made us sure to continue our in-clinic antibiotics protocol.

Renal Disease and Transplantation Forum 2024, vol. 17, no. 4, 136–141

Keywords: peritoneal dialysis, catheter-related infections, exit-site infection, tunnel inflammation

INTRODUCTION

Initiation and performance of peritoneal dialysis (PD) requires using a properly functioning Tenckhoff catheter. As with any other foreign material implanted into a human body, the catheter is an independent risk factor for infection. Infections associated with PD catheters include exit site and tunnel infections. They may develop as separate disease states or co-occur in the same patient [1]. The presence of dialysis-associated peritonitis (DAP) must be excluded in any type of PD catheter-related infection. Such co-infection is an indication of immediate removal of the PD catheter and switching to hemodialysis.

According to the 2023 International Society for Peritoneal Dialysis (ISPD) guidelines, Tenckhoff catheter exit site infections are defined as infections manifesting as the presence of purulent discharge at the PD catheter exit site with or without surrounding skin erythema [1]. Skin erythema, increased warmth, or oedema alone in the affected area constitute only intermediate symptoms [2], which warrant increased clinical vigilance as any other change observed in the PD catheter exit site area. PD catheter tunnel infections, in turn, are defined as the presence of symptoms such as swelling, erythema, and tenderness along the catheter tunnel. Ultrasonographic evidence of a fluid collection in the catheter area is only confirmatory.

The latest ISPD recommendations provided updated guidelines regarding empirical treatment of catheter-related infections. The recommended first-line treatment is a first-generation cephalosporin or anti-staphylococcal penicillin (cloxacillin or amoxicillin with clavulanic acid). In the event of known *Pseudomonas aeruginosa* infection, additional treatment with antipseudomonal antibiotic (e.g. fluoroquinolone) is recommended. The recommendation authors acknowledge the differences between dialysis centers in terms of incidence and antibiotic resistance of the most common pathogens causing catheter-related infections. Consequently, they allow modifications of the recommended treatment regimens based on local microbiologic testing. The objective of our study was to investigate microorganisms causing exit site and tunnel infections as well as their resistance to currently used antibiotics (1st generation cephalosporins and fluoroquinolones) and ultimately to propose recommendations regarding empirical antibiotic treatment in our institution.

MATERIAL AND METHODS

We conducted a retrospective study at the Peritoneal Dialysis Outpatient Clinic of the

Address for correspondence:
Szymon Drągowski,
1st Department of Nephrology, Transplantology, and Internal Medicine with Dialysis Center, Medical University of Bialystok
Żurawia 14, 15–540 Bialystok,
e-mail:
szymondragowski1985@gmail.com

1st Department of Nephrology, Transplantology and Internal Medicine, Medical University of Bialystok. It involved data collected from 2019 to 2023. Our analysis included all the cases in which purulent discharge specimens were obtained from the Tenckhoff catheter exit sites. The swab test results were analyzed in terms of the type of pathogen that was cultured and its susceptibility to ciprofloxacin and 1st generation cephalosporins (Tab. 1).

RESULTS

During the analysed period, 52 catheter-related infections were identified. The annual number of diagnoses of this complication ranged from 6 to 13 (Fig. 1). To standardise the infection control process, ISPD recommends calculating the rate of infection based on patient-years. Thus, the infection rate is measured as the number of infection episodes divided by the number of patient-years at risk (*i.e.*, the number of years on PD starting from the time of Tenckhoff catheter insertion). The rate should not exceed 0.40 [1]. For the analyzed period, the infection rate in our institution was 0.12–0.26 episodes per patient-year.

Most of the PD catheter exit site infections (59.6%) were caused by Gram-positive bacteria, which accounted for 46–81% of infections identified in the years under review. Of all acquired swabs, five (9.6%) were negative for bacterial growth, whereas in 6 (11.5%), growth of more than one pathogen was observed (Fig. 2).

The bacterial species most often identified in the tested swabs was *Staphylococcus* (52%), with *S. aureus* being the most prevalent. Other Gram-positive bacteria identified included *Enterococcus, Micrococcus, Kytococcus*, and *Corynebacterium*. The most prevalent Gram-negative bacterium was *Pseudomonas aeruginosa* (cultured in 70% of the cases, which accounts for 13% of all specimens collected). Other Gram-negative bacteria

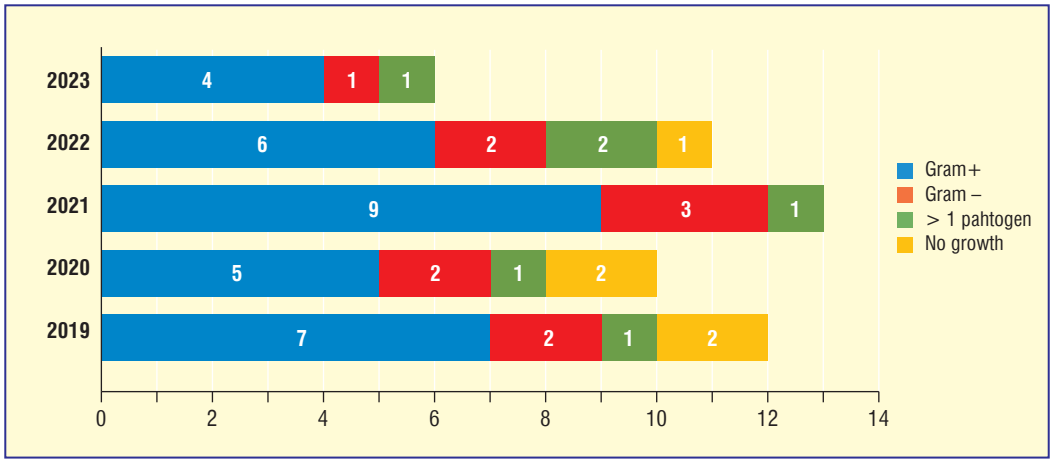

Figure 1. Number of catheter-related infections in the years 2019–2023 and their causative pathogens

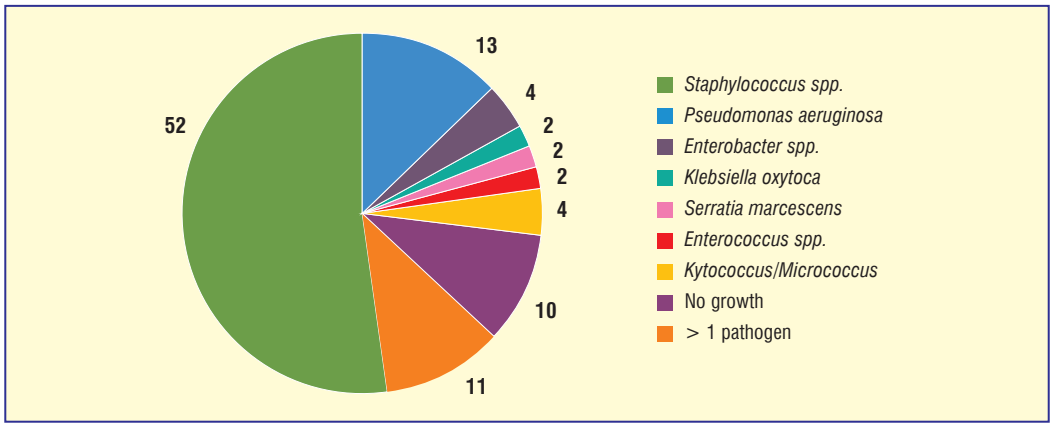

Figure 2. Proportions of pathogens cultured from specimens collected from the Tenckhoff catheter exit sites in the study period

Table 1. Culture and sensitivity analysis results for the swabs collected in the study (2019–2023)

Number/year	Bacterial Strain	Cephalosporin	Ciprofloxacin
1//23	*Klebsiella oxytoca*	S	S
2//23	*S. warneri/Clostridium/Corynobacter*	R/S/R	R/NR/R
3//23	*Staphylococcus aureus*	S	I
4//23	*Staphylococcus epidermidis*	S	I
5//23	*Staphylococcus aureus*	S	I
6//23	*Staphylococcus aureus*	S	I
1//22	*Staphylococcus aureus*	S	I
2//22	*Staphylococcus aureus*	R	I
3//22	NO GROWTH	---.	---.
4//22	*Staphylococcus aureus*	S	I
5//22	*Serratia marcescens/ S. aureus*	NR/S	S/I
6//22	*Staphylococcus aureus*	S	I
7//22	*P. aeruginosa/Klebsiella oxytoca*	NR/S	I/S
8//22	*Enterobacter cloacae*	NR	S
9//22	*Staphylococcus aureus*	S	I
10//22	*Pseudomonas aeruginosa*	NR	I
11//22	*Staphylococcus aureus*	S	I
1//21	*Staphylococcus aureus*	S	I
2//21	*Staphylococcus aureus*	S	I
3//21	*Staphylococcus aureus*	R	I
4//21	*Staphylococcus aureus*	R	R
5//21	*Staphylococcus aureus*	R	R
6//21	*Staphylococcus aureus*	S	I
7//21	*Pseudomonas aeruginosa*	NR	I
8//21	*Pseudomonas aeruginosa*	NR	I
9//21	*Enterobacter aerorenes*	NR	S
10//21	*Staphylococcus aureus*	S	I
11//21	*Staphylococcus warneri*	S	I
12//21	*Staphylococcus aureus*	S	I
13//21	*P. aeruginosa/S. warneri*	NR/R	I/S
1//20	*Serratia marcescens*	NR	S
2//20	*Pseudomonas aeruginosa*	NR	S
3//20	*Staphylococcus aureus*	S	S
4//20	*Enterobacter cloacae/ S. aureus*	NR/S	S/I
5//20	NO GROWTH	---.	---.
6//20	*Staphylococcus aureus*	S	I
7//20	NO GROWTH	---.	---.
8//20	*Staphylococcus aureus*	S	R
9//20	*Staphylococcus aureus*	S	R
10//20	*Enterococcus faecalis*	NR	NR
1//19	*Kytococcus sedentarius*	---.	---.
2//19	NO GROWTH	---.	---.

→

Table 1. cont. Culture and sensitivity analysis results for the swabs collected in the study (2019–2023)

Number/year	Bacterial Strain	Cephalosporin	Ciprofloxacin
3//19	*Staphylococcus aureus/ E. coli*	S/S	S/S
4//19	NO GROWTH	---.	---.
5//19	*Pseudomonas aeruginosa*	NR	S
6//19	*Staphylococcus aureus*	S	R
7//19	*Staphylococcus aureus*	R	R
8//19	*Staphylococcus simulans*	S	S
9//19	*Pseudomonas aeruginosa*	NR	S
10//19	*Pseudomonas aeruginosa*	NR	S
11/19	*Staphylococcus aureus*	S	S
12//19	*Micrococcus luteus*	---.	---.

R — resistant; S — susceptible; I — intermediate; NR — natural resistance; ---. — no growth

detected in the swabs were *Klebsiella, Serratia*, and *Enterobacter*.

The specific pathogens identified in the analysis were also assessed in terms of antibiotic resistance, with a particular focus on 1st generation cephalosporins and fluoroquinolones. Of all the bacterial strains isolated from patient swabs (if multiple strains were cultured from a single swab, each strain was analyzed separately), 68% were Gram-positive bacteria. Of this, 22 (40%) were susceptible to both antibiotic classes, three (6%) showed susceptibility only to fluoroquinolones, and two (4%) to 1st generation cephalosporins. Six types of Gram-positive bacteria (11%) were resistant to both classes of chemotherapeutic agents evaluated in the study. All the Gram-negative bacteria (17, which is 32% of all identified strains) showed susceptibility to fluoroquinolones; however, only three of them were susceptible to 1st generation cephalosporins (Tab. 2).

CONCLUSIONS

Our study demonstrated that more than 42% of bacteria causing Tenckhoff catheter exit site or tunnel infections at our site are resistant to 1st generation cephalosporins. If pathogens resistant to both beta-lactam antibiotics and fluoroquinolones are removed from our analysis [6], as they will not respond to standard empirical treatment with recommended antibiotics, nearly 35% of bacteria still fall outside the spectrum of 1st generation cephalosporin monotherapy. Delayed initiation of appropriate PD catheter-associated infection may result in the progression of the condition, leading to catheter removal and discontinuation of peritoneal dialysis. Taking into account the study results presented above, we decided to continue our in-clinic empirical combination treatment regimen with cephalosporin and ciprofloxacin.

DISCUSSION

Infections associated with Tenckhoff catheters are most often caused by Gram-positive bacteria, primarily *Staphylococcus*. The most prevalent causative Gram-negative bacterium in these infections is *Pseudomonas aeruginosa*. Thus, the results obtained for the study population are consistent with general statistics. Moreover, in a 2005 study including 44 infections of PD catheter exit site, the rates of swabs in which Gram-positive and Gram-negative bacteria were detected (59% and 23%, respectively) were similar to those calculated in our analysis (59% and 19%) [3]. In only one case, *Corynebacterium* species was cultured from an exit site swab. *Corynebacterium* is a genus of Gram-positive, club-shaped bacteria found as commensals in the skin and mucous membranes. According to available literature, they lead to catheter-associated infections much more frequently, accounting for up to 10% of all cultured pathogens [4].

Rare pathogens isolated in the study population include *Micrococcus* and *Kytococcus*, which are part of normal bacterial flora of the skin and mucous membranes and are highly prevalent in residential settings [5]. In patients with immune deficiencies, such as individuals with end-stage renal disease, these seemingly harmless bacteria may lead to the development of life-threatening dialysis-associated

Table 2. Analysis of data obtained for 2019–2023

	Number	%	Susceptibility type Cephalosporin//Ciprofloxacin					
			S//I	R//S//I	R//R	S//R	NR//S/I	NR//R
Staphylococcus aureus	27	50%	19	2	4	2		
Staphylococcus emidermidis	1	1.85%	1					
Staphylococcus warneri	3	5.56%	1	1	1			
Staphylococcus simulans	1	1.85%	1					
Entrococcus	1	1.85%			1			
Micrococcus	1	1.85%						
Kytococcus sedentarius	1	1.85%						
Clostridium	1	1.85%						
Corynobacterium	1	1.85%						1
Klebsiella oxytoca	2	4.26%	2					
Serratia marcescens	2	4.26%					2	
Pseudomonas aeruginosa	9	19.15%					9	
Enterobacter	3	6.38%					3	
Escherichia coli	1	2.13%	1					

R — resistant; S — susceptible; I — intermediate; NR — natural resistance; ---. — no growth

peritonitis. In addition, *Kytococcus sedentarius* may cause pitted keratolysis (*keratoma sulcatum*) manifesting as crater-like erosions in the stratum corneum of the feet [6], as well as severe pneumonitis and arthritis [7, 8].

The latest ISPD guidelines recommend the daily use of mupirocin or gentamicin ointment around the exit site of the Tenckhoff catheter as a preventative measure for catheter-associated infections. Compared to the 2016 update, the level of these recommendations was reduced from 1A to 1C. This treatment regimen is not a standard of care in our clinic. Topical gentamicin is recommended in patients with PD catheter exit site and/or tunnel infections as supportive treatment. Some studies demonstrated that antibiotic prophylaxis leads to the replacement of pathogens causing catheter-associated infections [3, 9]. Routine use of mupirocin is associated with a considerable increase in the rates of infections caused by Gram-negative bacteria. In isolated cases, highly resistant *Staphylococcus aureus* was cultured from swabs acquired from patients receiving such treatment [9]. Patients treated with gentamicin more often present with yeast infections [3].

Our analysis demonstrated a change in the susceptibility of *Staphylococcus* bacteria to ciprofloxacin. In 2019–2020, the majority of cultured strains showed complete susceptibility to fluoroquinolones. Since 2021, however, all isolated *Staphylococci* have demonstrated intermediate susceptibility. This is since the European Committee on Antimicrobial Susceptibility Testing (EUCAST) changed its microbiological guidelines in 2020. The minimum inhibitory concentration (MIC) for *Staphylococci* was lowered (from 1 mg/L to 0.001 mg/L) [10], which translates into an increase of recommended therapeutic doses of ciprofloxacin up to 750 mg/day in clinical practice. The change was already incorporated in the 2022 ISPD guidelines regarding dialysis-associated peritonitis [11].

Consequently, a question arises as to whether it makes sense to use dual empirical therapy for PD catheter-associated infections. Our study demonstrated that over 40% of all pathogens cultured in our clinic were resistant to 1st generation cephalosporins. In some of the cases, the resistance was natural (*Serratia, Pseudomonas, Enterobacter*), while in others – acquired. Taking this into account, as well as the absence of cases in which treatment would be prolonged beyond the recommended duration of therapy (2–3 weeks, depending on the causative pathogen) and the absence of cases of complete treatment failure, the decision to continue empirical combination therapy with 1st generation cephalosporin and ciprofloxacin in our center seems to be undoubtedly warranted. The analysis presented in this paper confirms the great value of conducting

internal audits in dialysis centers to investigate the incidence and types of diagnosed infections as well as the susceptibility of identified pathogens. Awareness of local microbiologic conditions considerably reduces the risk of error in empirical antibiotic treatment.

ARTICLE INFORMATION AND DECLARATIONS

Author contributions:

All authors equally contributed to the creation of the article.

Funding:

None.

Conflict of interest:

The authors declare no conflict of interest.

References

1. Chow K, Li PT, Cho Y, et al. ISPD Catheter-related Infection Recommendations: 2023 Update. Peritoneal Dialysis International: Journal of the International Society for Peritoneal Dialysis. 2023; 43(3): 201–219, doi: 10.1177/08968608231172740.
2. Czerwiec K, Myślińska D, Wądołowska A, et al. Charakterystyka mediatorów zapalenia- rola cytokin prozapalnych. Ann Acad Med Gedan. 2016; 46: 53S–58S.
3. Bernardini J, Bender F, Florio T, et al. Randomized, double-blind trial of antibiotic exit site cream for prevention of exit site infection in peritoneal dialysis patients. J Am Soc Nephrol. 2005; 16(2): 539–545, doi: 10.1681/ASN.2004090773, indexed in Pubmed: 15625071.
4. Schiffl H, Mücke C, Lang SM. Exit-site infections by non-diphtheria corynebacteria in CAPD. Perit Dial Int. 2004; 24(5): 454–459, indexed in Pubmed: 15490985.
5. Folayan A, Mohandas K, Ambu S, et al. Kytococcus sedentarius and Micrococcus luteus: highly prevalent in indoor air and potentially deadly to the immunocompromised - should standards be set? Trop Biomed. 2018; 35(1): 149S–160S, indexed in Pubmed: 33601787.
6. Lewicka-Potocka Z., Szczerkowska-Dobosz A. Dziobata keratoliza – łagodna, często nierozpoznawana infekcyjna choroba skóry stóp. Przegl Dermatol. 2016; 103: 124S––126S.
7. Levenga H, Donnelly P, Blijlevens N, et al. Fatal hemorrhagic pneumonia caused by infection due to Kytococcus sedentarius--a pathogen or passenger? Ann Hematol. 2004; 83(7): 447–449, doi: 10.1007/s00277-003-0831-x, indexed in Pubmed: 14689234.
8. Lim KR, Son JS, Moon SY. Case Report of Infectious Spondylitis Caused by . Medicina (Kaunas). 2021; 57(8), doi: 10.3390/medicina57080797, indexed in Pubmed: 34441003.
9. Lobbedez T, Gardam M, Dedier H, et al. Routine use of mupirocin at the peritoneal catheter exit site and mupirocin resistance: still low after 7 years. Nephrol Dial Transplant. 2004; 19(12): 3140–3143, doi: 10.1093/ndt/gfh494, indexed in Pubmed: 15466881.
10. The European Committee on Antimicrobial Susceptibility Testing. Breakpoint tables for interpretation of MICs and zone diameters. Version 10.0. http://www.eucast.org (24.09.2024).
11. Li PKT, Chow KM, Cho Y, et al. ISPD peritonitis guideline recommendations: 2022 update on prevention and treatment. Perit Dial Int. 2022; 42(2): 110–153, doi: 10.1177/08968608221080586, indexed in Pubmed: 35264029.