

Original Research Article

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Exit-site Infections in Continuous Ambulatory Peritoneal Dialysis Patients, Taif, Saudi Arabia

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ABSTRACT

Peritonitis is the most common infectious complication seen in peritoneal dialysis (PD). exit site infection has been thought to predispose PD patients to peritonitis
Aim: to assesses exit-site infections in continuous ambulatory peritoneal dialysis patients, Taif, Saudi Arabia. Method: A total 150 patients on peritoneal dialysis were enrolled in this study, in Al-Hada Military Hospital Taif, Saudi Arabia, during the 5 months period from August to December 2015. Swabs were taken and processing under standard method. The age include from 35-60 years. Statistical analyses were performed using the SPSS. Result: Bacteria were grown from 51(33.9%) of the 150 exit site swabs taken. There is statistical significant difference between Sex/ gender and ESIs, in peritoneal dialysate patients, female 70(46.6%) P 0.04, while grade 3 P 0.04, and in 56-60 year 40 (26.6%) P 0.04. The most commonly isolated organisms are, *Staphylococcus aureus* 15 (29.4%), MRSA 6(11.7%), *E.coli* 12(23.5%), *Pseudomonas aeruginosa* 9(17.6%), *Acinetobacter baumannii* 3 (5.8%), and *Serratia marcescens* 6(11.7%). The susceptibility pattern of bacteria isolated against 23 antimicrobial agents. All strains were susceptible to some antibiotic, resistance was observed in some strains. Conclusion :This study highlights the need for permanent evaluation by nurses on PD procedure performed by patients, family members, such as proper hand hygiene and hygiene of the skin near the insertion of the catheter.

Keywords

Exit-site infection, ESI, infection; Peritonitis, Microbiology, Peritoneal dialysis, Taif.

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Introduction

Peritonitis is a leading cause of technique failure and morbidity in patients undergoing renal replacement therapy with peritoneal dialysis (PD) (1,2). Although the frequency of peritonitis has decreased over the past decade due to improvements in connectology, PD peritonitis still accounts for approximately one-third of all technique failures on PD (3). It is generally accepted that exit site infections (ESIs) may directly

lead to peritonitis. The suggested mechanism includes a movement of bacteria from the exit site into the peritoneum via peri-luminal migration along the PD catheter tunnel. Although topical antibacterial agents can prevent ESI and reduce peritonitis rates, there is limited evidence exploring the relationship between ESI and subsequent peritonitis. Furthermore, the specific risk of peritonitis related to different classes of bacterial pathogens remains unknown (4).

ESI in the immediate post-catheter implantation period may depend on surgical procedures, bacterial colonization, and trauma. Later ESIs occur almost unpredictably, possibly related to mechanical irritation, hypersensitivity to silicone rubber, hyperhydrosis, or reduced tissue reactivity (5). The infection can migrate to the outer and inner cuffs, spread to the peritoneal cavity, and lead to tunnel infection, peritonitis, and even catheter loss(6).

During the 1990s, the overall probability of developing an ESI was 33% – 46% at 1 year and 59% – 70% at 3 years on continuous ambulatory PD (CAPD). Peritonitis induced by an ESI is found in 30% – 50% of patients, and catheter loss may be as high as 15% – 57% (7,8). Systematic reviews demonstrated that the method of implantation, type of catheter, specific exit-site care protocol, and mode of dialysis (CAPD, automated PD (APD)) did not significantly influence peritonitis or ESI rates (9). But mupirocin prophylaxis led to a 63% reduction in the risk of infection with *Staphylococcus aureus*, with peritonitis being reduced by 66% and ESIs by 62% (10). The bacteria colonizing the exit site are the same as those responsible for exit-site infections, but somewhat different from those causing peritonitis (11).

In a peritoneal dialysis population receiving no antimicrobial prophylaxis, approximately one-half of healthy exit sites are colonized by *Staphylococcus aureus*, which also accounts for over 50 % of exit-site infections., *Staphylococcus epidermidis* 20%, *Pseudomonas aeruginosa* 8%, and *Escherichia coli* 4%. Nasal carriage of *S. aureus*, common among patients undergoing peritoneal dialysis, also increases the risk of recurrent exit-site infections (12).

With the widespread usage of prophylactic antimicrobial applications at the exit site,

there has been a change in the organisms leading to exit-site infections. In a study using gentamicin cream at the exit site (13), the causes of exit-site infection were *S. aureus* in 33%, other Gram-positive organisms in 27%, yeast in 20%, sterile culture in 13%, and Gram-negative organisms in 7%. Innovations in connectology and exit-site bacterial prophylaxis have led to a reduced incidence of both peritonitis and exit-site infections in patients on peritoneal dialysis. However, exit-site infections are still a source of morbidity in these patients, and the rate of exit-site infections parallels the rate of patient transfer from peritoneal dialysis to hemodialysis.

The International Society for Peritoneal Dialysis (ISPD) has recommended that the targeted rates for *S. aureus*-related catheter infections be less than 0.05 episodes/patient year at risk, with an overall catheter infection rate of 0.2 episodes per patient year at risk or less (14). These pathogens demonstrate inducible beta-lactamase during initial therapy, potentially leading to empirical regimen failure, prolonged peritoneal damage, and worse outcomes (15). In the ANZDATA registry, the SPICE group of pathogens accounts for 26.9% of all non-*Pseudomonas* GNB PD-associated peritonitis, and *Acinetobacter* species are responsible for, 20% of these cases (16,17). Intuitively thinking, patients with *Acinetobacter* PD associated peritonitis might have poorer prognoses compared with the other *Enterobacteriaceae* members, owing to their high antibiotic resistance rates. However, past reports suggested just the opposite, with technique failure rates of 9% (18) and 9.2% (19) in several studies. In addition, several researchers proposed that *Acinetobacter* peritonitis might occur with an immunocompromised status (20). These reports were all published nearly 2 decades

ago, and the temporal changes of clinical characteristics, microbiologic features, and outcomes of patients with *Acinetobacter* PD peritonitis are unknown.

ESI with *Pseudomonas* is recognized as a major complication of PD, with high risk of catheter loss due to refractory/recurrent infection or peritonitis. Felix *et al.* 2015 (21) found *Pseudomonas* responsible of ESI 135(10.3%). There is remarkably little literature about treatment outcomes in patients with *Pseudomonas* ESI and there is no standard treatment protocol. The reported cure rate of *Pseudomonas* ESI with different systemic antibiotic treatment regimens ranges from 42 to 83% (22–23). Antimicrobial prophylaxis is recommended in addition to the normal daily exit-site care. This approach likely works in part by decreasing the number of potentially pathogenic bacteria that colonize the exit site; so, if trauma occurs, there are few bacteria that can cause tissue invasion and an infection. Antimicrobial prophylaxis requires both a patient-oriented and center-oriented approach (24).

International Society for Peritoneal Dialysis guidelines advise the use of one to two systemic antibiotics in case of *Pseudomonas* ESI (25). There are no data or recommendations about any topical treatment of *Pseudomonas* ESI.

Bernardini *et al.* (26) showed that topical prophylaxis at the exit site with gentamicin results in an equal reduction of ESI with Gram-positive organisms compared with mupirocin and also a reduction in ESI with Gram-negative organisms including *Pseudomonas*. The aim of the present study was to study the exit-site infections in continuous ambulatory peritoneal dialysis patients, Taif, Saudi Arabia

Materials and Methods

Study Population

This study included 150 patients on peritoneal dialysis were enrolled in this study, in Al-Hada Military Hospital Taif, Saudi Arabia, during the 5 months period from August 2015 to December 2015, suffering various forms of Exit site infection (SSIs). Official approval from directors of the hospital has been obtained, after clarification of the aim of the study and assuring the confidentiality to them.

Specimen Collection

Two Swabs from peritoneal catheter exit-sites were taken. The skin close to the exit-site of the catheter was also swabbed in a circular manner. Both swabs were placed in Stuart's transport medium (Culturette system, Becton Dickinson, Cockeysville, MD, USA) and sent to the microbiological laboratory. Immediately, swabs were plated onto both 5% blood, McConkey, Chocolate agar, Sabourad Dextrose Agar (SABDEX), Saudi Prepared Media Laboratory, Saudi Arabia, Riyadh (SPML), and incubated aerobically at 37°C for 18–24 h,

The demographic data of the patients and the diagnostic criteria were collected by the treating dialysis team. Other data including associated risks factors (i.e. diabetes, obesity, steroid therapy), use of prophylactic antimicrobial agents, the type and duration of dialysis, clinical evaluation of wound (considered infected if there was pus discharge or redness and swelling with fever), and laboratory data (including Gram stain, culture results, identification of the bacterial isolates as well as antimicrobial susceptibility) were recorded on a data sheet.

Sample Processing

Direct examination of specimens: The first swab was used to prepare two direct smears. One was examined after adding 10% KOH solution for fungal identification. The other was stained by Gram stain for bacterial examination and detection of PMNL which is an important feature in case of bacterial infection rather than in bacterial colonization. Plates were incubated at 37° C for 48 h. Bacteria were identified by means of standard laboratory identification methods. Oxacillin resistance testing was performed for *Staphylococcus aureus* isolates by use of oxacillin screen agar (Saudi Prepared Media Laboratory, Saudi Arabia, Riyadh (SPML)). For each sample, total bacterial counts were enumerated, and the 3 most prevalent organisms were recorded, in order of density.

Species Identification

Bacterial growths yields was identified according to standard conventional procedures :

The species identification was based on Gram-stain, catalase test, oxidase test, indole test, staphyloslide test kit (BBL Staphyloslide), sugar assimilation test, sugar fermentation test.

Identified isolates were stored on nutrient agar slant at room temperature for subsequent susceptibility testing.

Commercial identification kits were used to identify the isolates up to species level Different type of API kits (Analytab product, Plainview, N.Y), and Vitek system, different card for identification of Gram-positive bacteria, Gram-negative bacteria, yeast (bioMérieux, Inc. Durham NC,USA).

Afterwards, the sensitivity to the antibiotics was accomplished by disk diffusion test performed for all the isolates by the method recommended by Clinical and Laboratory Standard Institute (CLSI). A suspension of each isolate was made so that the turbidity was equal to 0.5 McFarland turbidity standard and then plated onto Muller-Hinton agar (Saudi Prepared Media Laboratory, Saudi Arabia, Riyadh (SPML)).Antibiotic disks (Oxoid) were applied to each plate. After incubation at 37°C for 24 h, inhibition zone size was measured. The patients received the proper antibiotic thereafter. Twenty three types of antibiotics were used in both Gram-negative rod, and Gram-positive cocci; Amoxicillin/ Clavulanic acid (20/10µg), Cephalotin(30 µg), Oxacillin (1µg), Gentamicin (10µg), Sulfamethoxazole/ Trimethoprim (1.25/23.75µg), Ciprofloxacin (5µg), Clindamycin (2µg), Vancomycin(30µ), Cefoxitin (30µg), Cefoxithin (30µg), Ceftazidime(30µg), Cefotaxime (30µg), Amikacin (30 µg), Ceftriaxone (30 µg), Ceftazidime (30 µg), Ampicillin/Sulbactam (10/10), Cefotaxim (30µg), Ticarcillin/ clavulanic acid (75/10µg), Imipenem (50µg)), Cefepime (10µg), Ampicillin/ Sulbactam (10/10 µg), Aztreonam (30 µg), Piperacillin/ tazobactam (100/10 µg).

Quality Control

To maintain the quality of data every sample was processed in triplicates and every result was cross checked by the principal investigator. *Enterococcus faecalis* (ATCC 29212), *Staphylococcus aureus* (ATCC 24923), *Streptococcus pyogenes* (ATCC 19615), *E.coli* (ATCC 25922), *Pseudomonas aeruginosa* (ATCC 27853) were used as quality control throughout the study for culture, Gram stain. All the strains were obtained from the (ATCC, The essential of live science research, USA)

Data Analysis

Statistical analyses were performed using the Statistical Package for the Social Science (SPSS), Version 16 for Windows. Continuous variables were summarized using descriptive statistics in terms of means, \pm standard deviations, T.test; 95% confidence intervals (95% CI), P value < 0.05 were considered significant.

Results and Discussion

This study included 150 patients, 10 child/boy (4.6%), 10 chilled /girl (4.6%), adult/male 90 (41.4%), adult/female 107 (49.3%), their ages ranged from 35 years to 60 years. 51 samples were positive for culture 51(33.9%), and 99(65.4%) was negative growth.

Bacteria were grown from 51(33.9%) of the 150 exit site swabs taken; Male 80(53.3%), while female 70 presented in rate of (46.6%). Bacterial growth in ES swabs was isolated from 51(33.9%) of these (Table 2). In grade 0/1 exit-site infections, bacteria was isolated 11 times (7.3%) of 150 swabs taken, in grade 2 positive culture was found in 24(16%), while grade 3, and 4 were presented in low rate of 10(6.6%), 6(4%), respectively (Table 2). There was no enrollment restriction based on age, gender, end-stage renal diseases or previous renal replacement therapy. There is statistical significant difference between Sex/ gender and ESIs, in peritoneal dialysate patients, female 70(46.6%) P 0.04.

The grade of positive catheter-exit-site infection was categorized independently from the microbiological results following the ES-grade bacterial growth in ES swabs. The total positive culture 51(33.9%) out of 150 samples. The grade 2 presented in high range was 24 (16%), while grade 0/1 followed 11 (7.3%). In contrast grade 3,4

found in low percentage of 10 (6.6%), 6 (4%) respectively. Table 2. There is statistical significant difference between bacterial growth in ES swabs and ESIs, in peritoneal dialysate patients in grade 3, P 0.04.

The main group of the patient at peritoneal dialysate patient was at age of 50-55 year 50(33.3%), followed 56-60 year 40(26.6%), while the age of 45-49 year gave the rate of 24 (16%), In contrast age 40-44, and 35-39 year presented in the percentage of 20(13.3%), 16(10.5%), respectfully. There is statistical significant difference between age in years in ESIs patient at 56-60 year 40(26.6%) P 0.04.

The grade of catheter-exit-site infection was categorized independently from the microbiological results following the ES-grade bacterial growth in ES swabs. Total classification of Twardowski (13), Table 4. The physician on duty during each ambulatory visit documented the clinical grading of infection in the patient's records. Exit-site infection Positive Negative grades 2, 3 and 4 were treated with local aseptic ointment and intravenous antibiotic (vancomycin) was given for exit site infection grades 3 and 4. Swabs were taken before and 2 weeks after the end of the antiseptic and/or antibiotic treatment.

Bacteria were grown from 51(33.9%) of the 150 exit site swabs taken;

Staphylococcus aureus predominant bacteria 15(29.4%), in grade 2, (7,46.6%), while in grade 0/1(4,26.6%), and in grade 3, and 4 presented in same range of (13.3%)

MRSA followed in 6(11.7%) in grade 2 presented in high rate of (3,50%), while in grade 0/1,3, and 4 presented in same range of 1(16.5%)

E.coli isolated 12 times (23.5%) in grade 2 presented in high rate of 7(58.3,50%), while in grade 0/1,3,and4 presented in low range of 2(16.6%), 1(8.3%), respectively.

Pseudomonas aeruginosa isolated 9 times 17.6%, in grade 2 presented in high rate of 4(44.4%), while in grade 0/1,3,and4 presented in low range of 2 (22.2%), 1 (11.1%), respectively.

Acinetobacter baumannii isolated 3 times 5.8%, in grade 0/1,2,3 presented in the same rate of 1(33.3%),and not isolated from grade 4.

Serratia marcescens isolated 6 times 11.7%, in grade 2 presented in high rate of 3(33.3%),while in grade 0/1,and4 presented in low range of 1(16.6%). Table 5. Fig1.

Antibiotic Sensitivity

Disk diffusion method was performed to all bacterial isolates causing infection. Among these isolates, many were found to be resistant to more than one antibiotic. The susceptibility pattern of bacteria isolated from ESIs patient against 23 antimicrobial agents Table 5,6,7.

Staphylococcus aureus found to be resistant in 15 out of 99 cases representing 29.4%. The result of this study revealed that, resistant of *Staphylococcus aureus* to 15 antibiotic, and fully susceptible to oxacillin, vancomycin, and penicillin. All strains were susceptible to some antibiotic used in study, and resistance was observed in some strains of *Staphylococcus aureus*, the different isolates' resistance to various antibiotics in percent study (Table 5). The antimicrobial susceptibility pattern of MRSA isolates against antimicrobial agents are summarized in Table 6. More than 6(100%) of MRSA isolates were resistant to oxacillin, co-

trimoxazole, gentamicin, amikacin, ciprofloxacin, ceftriaxone, ceftazidime, ampicillin/ sulbactam, Amoxicillin/ Clavulanic acid, Penicillin, Cephalothin. All stains showed sensitive to vancomycin, clindamycin,

E.coli found to be resistant in 12 out of 51 cases representing 23.5%, while *Pseudomonas aeruginosa* 9 (17.6%). In contrast *Acinetobacter baumannii* found to be resistant in 3(5.8%), and *Serratia marcescens* was resistant to 6 (11.7%). *E.coli* was fully sensitive to ceftriaxone, imipenem, and cefepime, while *Pseudomonas aeruginosa* was sensitive to cefoxitin, amikacin, ciprofloxacin, ceftriaxone, ampicillin/ sulbactam, ticarcillin/clavulanic acid, *Acinetobacter baumannii*, and *Serratia marcescens*, were sensitive to both antibiotics imipenem, and cefepim.

ESI should be considered with the development of rash at the PD catheter exit site ESI is a major risk factor for the development and treatment of ESI are essential (28). Skin infection at the catheter exit site remains a relevant problem in PD patients. Peritonitis episodes are usually easily identified and counted, but exit sites vary broadly in appearance from uninfected to infected, making for a wide variation in ESI classification and treatment between PD units. This variation leads to imprecise definitions of ESI, inconsistent monitoring, and difficulties in interpreting study results. In trying to avoid these difficulties, we considered ESI only when signs of infection were present and cultures were available (29). The difficulty in microbiologic ESI diagnosis is highlighted in that regional commensal flora is often reported in clinically evident ESIs. Total samples enrolled in this study was 150. The incidence of ESI in the present study was 51(333%),

which is higher than reported worldwide incidence of Burkhard et al (30) on exit site infections which reported, bacteria were grown from 99 (26%).

The result of present study revealed that, *Staphylococcus aureus* predominant bacteria 15(29.4%), *E.coli* followed in isolated 12(23.5%), while *Pseudomonas aeruginosa* isolated 9 times (17.6%). In contrast MRSA, *Serratia marcescens*, *Acinetobacter baumannii* were presented in the same low rate of 6(11.7%). This result was in agreement with the finding reported by Burkhard et al (30), who found that, rate of ESI was higher in grade 0/1 exit-site infections, *S. aureus* isolates was isolated 15 (20%), and in pared with strains isolated in lower infectious grades grade 2, 3 and 4, *S. aureus* was found in 10 swabs (40%).

In other study, in adults, previously reported ESI rates range from 0.05 – 1.02 episodes/patient–year. In contrast, Gram-positive agents were responsible for most pericatheter infectious episodes, and *S. aureus* (at a rate of 0.46 per dialysis year at risk) was the primary cause of ESIs (31). A study indicated that the main risk factor for the occurrence of catheter exit-site infection is being a nasal *staphylococcus* carrier. Thereby, it is reinforced the importance of hand hygiene and use of masks by patients and caregivers, while performing peritoneal dialysis procedure (32).

In our study, found that *E.coli* was the most frequent Gram negative agent 12(23.5%), followed by *P. aeruginosa* 9(17.6%), while, *P. aeruginosa* was the most frequent Gram negative agent (8% – 12%), followed by other *Enterobacteriaceae* (7% – 14%). Felix et al.(2015) found that, *Pseudomonas* ESI in PD patients from 135 patient presented in low range of 14(10.3%) (21). Chia et al. (2014), found that *Acinetobacter baumannii*

after 2000, was 9 (64%) was the most common species identified from the effluent, and the leading causes of infection were sterility break and GI microflora translocation (33).

Previous studies have reported that age and longer dialysis duration were not associated with an increase in ESIs (34), but African American and prior renal transplant patients have an increased susceptibility to catheter-related infections (35). Diabetic and immunosuppressed patients are also at risk for early *S. aureus* ESIs. Patients on automated peritoneal dialysis (APD) were found to have lower rates of peritonitis, but not lower rates of ESIs or tunnel infections. The importance of peritoneal dialysis catheter exit site problems in determining the long-term success of CAPD therapy has recently been receiving increasing attention. Detailed analyses of CAPD technique failures have suggested that approximately (36).

There are limited data available to review with regard to ESI in Saudi Arabian patients. Al-Hwiesh et al.(37), reported that, Gram-positive ESI occurred in 17.1% vs 10.2% of patients ($p<0.05$), whereas 20% of and 5.1% of patients ($p<0.001$) had Gram-negative ESI in the 2 groups, respectively. While Ur-Rehman et al.(38), found exit-site infections occurred in 17 (30%) patients, Whereas Ghulam et al. (39), reported that, the most common causative organisms for peritonitis were *Pseudomonas* (16%), *Staphylococcus epidermidis* (16%), and *Staphylococcus aureus* (7%).

The International Society for Peritoneal Dialysis (ISPD) recommends cleaning of PD catheter exit site with antiseptic agent and application of topical antimicrobials, such as gentamicin or mupirocin, for the prevention of ESI (14). Topical gentamicin has been

shown to reduce ESI and peritonitis due to gram-positive and gram-negative organisms, while, topical mupirocin mainly reduced ESI due to gram-positive organisms. ESI is typically diagnosed clinically based on the finding of purulent or bloody drainage from PD catheter exit site, surrounding erythema, tenderness, and swelling. However, the presence of skin rash and erythema without drainage at the PD catheter exit site can be also due to early infection, allergic reaction to PD catheter material, or to mechanical trauma (40).By analyzing the results obtained in relation to sociodemographic

variables, it was observed consistency with those found by the Brazilian Society of Nephrology and by a cohort study named BRAZPD, performed in the South and Southeast regions of Brazil(41).The complexity of the peritoneal dialysis procedure is recognized. In this sense, the sociodemographic variables must be considered in establishing the diagnosis of cognitive, motor and affective skills of the patients and/or caregivers by the nurses, in order to prevent infectious complications in PD (42).

Table.1 Socio-demographic Characteristics (Sex, Gender) of Patient at Peritoneal Dialysate, Taif, N=150

Socio-demographic Characteristics Sex/ gender	Frequency N=150	%	P value
Male	80	53.3	
Female	70	46.6	0.04
Total	150	100	
Mean 1.5/75; Std + 0.707			

Table.2 Results of Bacterial Cultures from Exit-site (ES) Swabs (N=150)

ES-grade	Bacterial growth in ES swabs (%)		Total
	Positive	Negative	
0/1	11 (7.3%)	20 (13.3%)	31 ((20.6%)
2	24 (16%)	45 (30%)	69 (46%)
3	10 (6.6%) P 0.04	14 (9.3%)	24 (16%)
4	6 (4%)	20 (13.3%)	26 (17.3%)
Total	51(33.9%)	99 (65.9%)	150 (100%)

Table.3 Socio-demographic Characteristics (Age in Years) of Patient at Peritoneal Dialysate, Taif, N=150

Socio-demographic Characteristics	Frequency N=150	Percent (%)	P value
1- Age in years			
35-39	16	10.5	
40-44	20	13.3	
45-49	24	16	
50-55	50	33.3	
56-60	40	26.6	P 0.04
Total	150	100	
Mean 3/30; Std + 1.5/14.4			

Table.4 Clinical Grading of Exit-site Appearance (ES 0–4), According to ref. (27)

ES	Redness	Swelling	Pain	Secretion	Pus
0	no	no	no	no	no
1	< 2mm	no	no	no	no
2	< 2mm	no	no	+	+
3	< 2mm	yes	Yes	++	++
4	< 2mm	yes	yes	+++	+++

ES: Exit-site,+: present, ++: moderate, +++: intense

Table.5 Results of Positive Bacterial Cultures (N=150)

Positive ES swab (%)						
ES-grade	<i>Staphylococcus aureus</i> N.15(29.4%)	MRSA N.6(11.7%)	<i>E.coli</i> N.12(23.5%)	<i>Pseudomonas aeruginosa</i> N.9(17.6%)	<i>Acinetobacter baumannii</i> N.3(5.8%)	<i>Serratia marcescens</i> N.6(11.7%)
0/1	4 (26.6%)	1 (16.6%)	2 (16.6%)	2 (22.2%)	1 (33.3%)	1 (16.6%) P 0.01
2	7 (46.6%)	3 (50%)	7 (58.3%)	4 (44.4%)	1 (33.3%)	2 (33.3%)
3	2 (13.3%) P 0.03	1 (16.5%) P 0.03 P 0.05	2 (16.6%) P 0.03	2 (22.2%) P 0.03	1 (33.3%)	2 (33.3%)
4	2 (13.3%)	1 (16.5%)	1 (8.3%)	1 (11.1%)	NI	1 (16.6%)
Total	15	6	12	9	3	6

ES: Exit-site, NI:Not Isolated

Table.6 Antibiotic Susceptibility Pattern (%) of Resistant *Staphylococcus aureus*, and MRSA Isolates in ESI Patients

Antibiotics	Resistant <i>Staphylococcus aureus</i> N=15(29.4%)	Resistant MRSA N=6 (11.7%)
Amoxicillin/ Clavulanic acid (20/10 µg)	3(20%)	6(100%)
Cephalothin (30 µg)	2(13.3%)	5 (83.3)
Oxacillin (1 µg)	*S	6(100%)
Gentamicin (10 µg)	3 (20%)	6(100%)
Amikacin (30 µg)	2 (13.3%)	6(100%)
Ciprofloxacin (1 µg)	1 (6.6%)	6(100%)
Ceftriaxone (30 µg)	1(6.6%)	6(100%)
Co-trimoxazole (1.2/23.8 µg)	5(33.3%)	6(100%)
Ceftazidime (30 µg)	3(20%)	6(100%)
Ampicillin/Sulbactam (10/10)	2(13.3%)	6 (100%)
Penicillin (unit)	S	6 (100%)
Vancomycin (30 µg)	S	S
Clindamycin (2 µg)	S	S

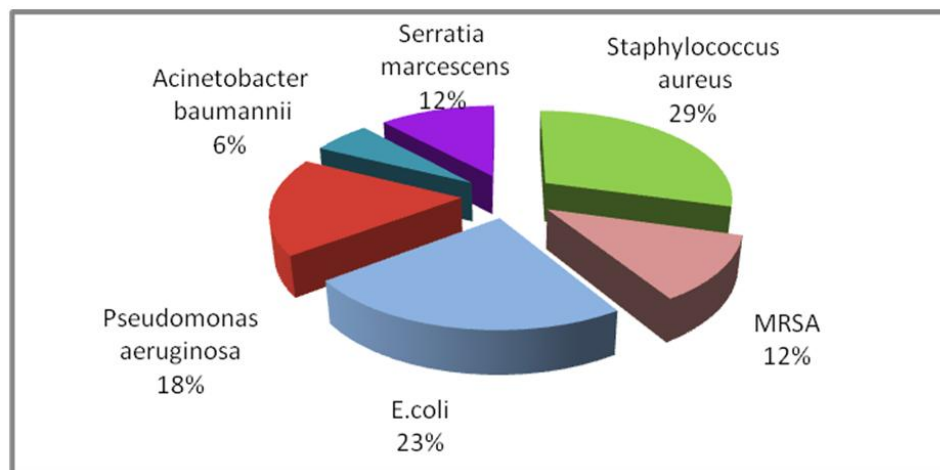
*S; sensitive

Table.7 Antibiotic Susceptibility Pattern (%) of Resistant Gram-Negative Isolates in ESI Patients

Antibiotics	Resistant <i>E.coli</i> N=12 (23.5%)	Resistant <i>Pseudomonas aeruginosa</i> N=9 (17.6%)	Resistant <i>Acinetobacter baumannii</i> N= 3 (5.8%)	<i>Serratia marcescens</i> N.6 (11.7%)
Aztreonam (30 µg)	1(8.3%)	1(11.1%)	2(66.6%)	1(16.6%)
Cephalothin (30 µg)	3(25%)	2 (22.2%)	3(100%)	3(50%)
Cefoxithin (30 µg)	1(8.3%)	S	3(100%)	2 (33.3%)
Gentamicin (10 µg)	2(16.6%)	3(33.3%)	2(66.6%)	1(16.6%)
Amikacin (30 µg)	1(8.3%)	S	1(4%)	3(50%)
Ciprofloxacin (5 µg)	1(8.3%)	S	2(66.6%)	1(16.6%)
Ceftriaxone (30 µg)	*S	S	2(66.6%)	2 (33.3%)
Co-trimoxazole (1.2/23.8 µg)	4(33.3%)	2 (22.2%)	3(23.8%)	5(83.3%)
Ceftazidime (30 µg)	2(16.6%)	1(11.1%)	1(4.7%)	2 (33.3%)
Ampicillin/Sulbactam (10/10 µg)	1(8.3%)	S	1(4.7%)	1(16.6%)
Cefotaxim (30 µg)	3(25%)	1(11.1%)	2(66.6%)	1(16.6%)
Ticarcillin/clavulanic acid (75/10 µg)	2(16.6%)	S	2(66.6%)	2 (33.3%)
Piperacillin/tazobactam (100/10 µg)	1(8.3%)	1(11.1%)	2(66.6%)	1(16.6%)
Imipenem (10 µg)	S	S	S	S
Cefepime (10 µg)	S	S	S	S

*S; sensitive

Fig.1 Frequency Distribution of Bacteria Isolated from Exit Site



The results obtained in this study showed that, 33.9% of patients were admitted to the dialysis program with a primary diagnosis of unspecified kidney disease (43). This result shows that, at the study site, the number of patients on PD knowledge of the primary disease is high. This may reflect the time spent by the patient waiting for the first

medical consultation. In a study by Lo et al. (44), 40.2% of ESI episodes were caused by *P. aeruginosa*, and early removal of the catheter was recommended. Kazmi et al. (45) noted that, of 18 episodes of ESI caused by *P. aeruginosa*, 15 (83%) resolved with antibiotic therapy; only 3 (17%) required catheter removal.

All isolates of *S. aureus*, and MRSA were sensitive to oxacillin, vancomycin, clindamycin, also found resistant in some strains. Table 6. Vancomycin remains the first choice of treatment for MRSA and to preserve its value, vancomycin use should be limited to those cases where there are clearly needed (46). The susceptibility testing of the Gram-negative organisms; *E. coli* showed that higher resistant to, cotrimoxazole, cefotaxime, while *Pseudomonas aeruginosa* resistant to cephalothin, gentamicin. In contrast, *Acinetobacter baumannii* presented and resistant to antibiotics, ciprofloxacin, ceftriaxone, aztreonam, cephalothin, cefoxithin, Ticarcillin/clavulanic acid with high percentage, and *Serratia marcescens* showed high rate of resistant to cotrimoxazole, cephalothin, cefoxithin, ticarcillin/ clavulanic acid

In conclusion, Continuous ambulatory peritoneal dialysis is a viable therapy option in ESRD patients in Saudi Arabia. Peritonitis and exit-site infection are the main problems encountered, but their prevalence's are comparable to those seen in studies from PD centers in other countries. Eradication of *Pseudomonas* ESI remains difficult even with the addition of topical gentamicin to the exit site. The ideal systemic antibiotic treatment is still to be determined. There should be a low threshold for catheter replacement in case of unresolved infection, as the risk of occurrence of *Pseudomonas* peritonitis is high. The maintenance of peritoneal catheter is the patient's responsibility, with the supervision of the healthcare team. The nurses play a key role, since they are responsible for the professional training of patients, families and caregivers. The constant monitoring favors safety for the procedure in PD, in order to reduce future complications and maintain the quality of life of patients.

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