

Comparing the Effect of Dressing Versus No-dressing on Exit Site Infection and Peritonitis in Chronic Ambulatory Peritoneal Dialysis Patients

Abstract

Background: Peritonitis and exit site (ES) infection are two main complications of peritoneal dialysis. There are some controversies regard to preventive strategies for ES care. In this study we compared peritonitis and ES infection rates in patients with and without dressing. **Materials and Methods:** This historical cohort study carried out on 72 patients under continuous ambulatory peritoneal dialysis treatment, 54 with dressing versus 18 patients without dressing, followed from October 1, 2010 to March 31, 2011 for peritonitis and ES infection. **Results:** A total of 17 episodes of ES infection occurred in 12 patients in dressing group, but no case was seen in no-dressing group ($P = 0.02$). Twenty-one episodes of peritonitis occurred in 15 patients in both groups (one episode every 20.6 patient-months). In no-dressing group two episodes occurred in only one patient (one episode every 54 patient-months), and in dressing group, 19 episode in 14 patients (one episode every 17.1 patient-months) ($P = 0.03$). Peritonitis was significantly more frequent in male versus female in overall patients (38% vs. 14%, $P = 0.025$) and in dressing group (52% vs. 15%, $P = 0.003$). In dressing group, peritonitis was more frequent in diabetics versus non-diabetics (48% vs. 11%, $P = 0.01$). Odds ratio for developing peritonitis was 9.4 in dressing group (95% confidence interval [CI] = 1.05 – 84.4; $P = 0.045$), and 4.4 in men (95% CI = 1.26 – 15.19; $P = 0.02$). **Conclusion:** In this study, chronic ES care without dressing was associated with lower risk of peritonitis and ES infection.

Keywords: Continuous ambulatory peritoneal dialysis, dressing, exit site infection, peritonitis

Introduction

Peritoneal dialysis (PD) is an accepted mode of renal replacement therapy in end stage renal disease patients. Peritonitis and exit site (ES) infection are Achill's heels of PD patients.^[1]

Peritonitis is one of the major causes of hospitalization, dialysis technique failure and death in patients undergoing PD,^[1-4] thus innovation in preventive methods of peritonitis and ES infection is the main objective for PD healthcare centers in order to reduce the morbidity in their patients.^[5,6]

It has been found that peritonitis is the cause of around 18% of the infection-related mortality in PD patients and <4% of peritonitis episodes result in death and also is a “contributing factor” to death in another 16% of deaths in these patients.^[6] In addition, peritonitis can lead to discontinuing PD program and switching to hemodialysis. Hence, it is very important to focus on prevention and treatment of

PD-related infections.^[4,7,8] For prevention of ES infection, there are different types of local antibiotic and antiseptic agents with different rates of success.^[9-14]

The widespread usage of prophylactic antimicrobial applications at the ES have led to adverse consequences including floral changes at the ES,^[15,16] the development of antimicrobial drug resistance^[17,18] and resistant infection of tunnel and ES and substantially increase healthcare costs.^[19,20]

The aim of this study was to compare the rate of peritonitis and ES infection in two groups of continuous ambulatory peritoneal dialysis (CAPD) patients with and without ES dressing.

Materials and Methods

Patients and settings

In a retrospective study during 6 months follow-up, we recorded the peritonitis and

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ES infection incidence rate in two groups of patients who were on CAPD. This historical cohort study has been carried out on 72 patients, aged 18 years old or more, in our PD center, Al-Zahra Hospital, Isfahan, Iran.

From October 1, 2010 to March 31, 2011, one group (no-dressing group) of eighteen patients who intentionally had not used any dressing and no special skin care except during each bath and kept it dry during the day, compared with other group (dressing group) of 54 patients who had used usual dressing with or without antiseptic or local antimicrobial agents (such as mupirocin, gentamycin, etc.). None of the patients in both groups received systemic antibiotic prophylaxis. Patients had been informed about using their anonymous data for research projects. In both groups, patients received usual antimicrobial management as the others in our center if acute ES infection and/or peritonitis would occur.

Assessments

The following data were collected from patients' documents. Patients' cause of renal failure and demographic characteristics included; age, gender, employment, educational state, urban/rural settlement, body mass index (BMI), visual ability and appetite (by subjective clinical assessment during first interview with patients and scaled as poor, good, excessive for appetite and as blind, poor, good for visual ability), and CAPD characteristics included time on CAPD, frequency of daily dialysis exchanges, catheter insertion duration, dialysis duration, and nasal mucosal culture results. Normalized protein catabolic rate (nPCR) and total, renal and peritoneal Kt/Vs were calculated by using PD ADEQUEST 2.0 for Windows (Baxter Healthcare Corporation, Deerfield, IL, U.S.A.). Laboratory data including hemoglobin, white blood cell count (WBC), serum total cholesterol, triglyceride, high density lipoprotein-cholesterol, low density lipoprotein-cholesterol (LDL-C), fasting blood sugar, calcium, phosphorus, albumin, intact parathyroid hormone, and serum iron, total iron binding capacity, ferritin level, peritoneal fluid WBC, polymorphonuclear (PMN) count and culture, which were checked every 2 months, were extracted from patients' records.

A peritoneal catheter ES infection was defined by the presence of purulent secretion, with or without skin erythema in the epidermal and catheter junction and has been categorized according to Twardowski and Prowant.^[21]

Peritonitis was defined by simultaneous occurrence of at least two of these three criteria: (1) Abdominal pain, cloudy peritoneal effluent, (2) Leukocyte count in the dialysate $\geq 100/\text{mm}^3$ and PMN $\geq 50/\text{mm}^3$, and (3) Positive culture of peritoneal fluid.^[6]

The peritonitis and ES infection events and causative microorganisms were recorded by the resultant of the peritoneal fluid or ES smear and culture. After obtaining

appropriate microbiological specimens, the patients were immediately treated with empiric antibiotics that cover both Gram-positive and Gram-negative organisms according to our center-specific selection dependent on the local history of sensitivities of organisms causing peritonitis. Therapy was adjusted by the cultures results.

The peritonitis and ES infection rates were calculated and compared between two groups.

Data analysis

The obtained data were analyzed by independent sample *t*-test, repeated measure analysis, Chi-square test and backward likelihood rate multiple logistic regression analysis using Statistical Package for Social Science (SPSS) version 18.0 for windows, (SPSS Inc., Chicago, USA). The peritonitis and ES infection rates were calculated and compared between two groups. A $P < 0.05$ was considered as significant in all analyses.

Results

Demographic characteristics are shown in Table 1. According to this table all characters were similar in both groups except for daily dialysis exchanges, which were more frequent in dressing ($P < 0.001$) and catheter insertion durations, which were more prolonged in no-dressing group ($P = 0.046$). Diabetes mellitus was the most common cause (50%) of renal failure in both groups.

Laboratory data and PD characteristics and BMI are shown in Table 2. With repeated measure analysis, during 6-months period, mean renal Kt/V was higher in no-dressing than dressing group ($P = 0.043$), but it was not different within each group ($P = 0.8$). Also mean total Kt/V between two groups ($P = 0.26$) and within each group ($P = 0.66$) was not significantly different during this period. At the beginning of the study, blood WBC counts in no-dressing group was statistically higher ($P = 0.024$) but at the end of the study this difference was lost its significance.

Exit site Infection, peritonitis, and PD fluid culture results are shown in Table 3. The prevalence of ES infection in dressing group was one episode every 19.1 patient-months. Of these episodes eight patients (66.7%) had one, three patients (25%) had two and one patient (8.3%) had three episodes and no cases was seen in no-dressing group ($P = 0.02$).

A total of 21 episodes of peritonitis occurred in 15 patients in both groups [Table 3]. In no-dressing group only two episodes occurred, both in one patient, and in dressing group, 10 patients (71.4%) had one; three patients (21.4%) had two and one patient (7.1%) had three episodes. According to Chi-square test, peritonitis rate was higher in dressing group than in no-dressing (25.9% vs. 5.6%, $P = 0.03$). The overall peritonitis rate was one episode every 20.6 patient-months, but dressing group had one episode every 17.1 patient-months and no-dressing group

Table 1: Comparison of demographic characteristics between dressing and no-dressing groups

Characteristics	Dressing	No-dressing	P
Age			
Year	58.9±15.9 [#]	61.3±14.76 [#]	0.58
Gender			
Male	21 (33.9)*	8 (44.4)*	0.68
Female	33 (61.1)*	10 (55.6)*	
Literacy			
Illiterate	17 (31.5)*	5 (27.8)*	0.76
College	29 (35.7)*	9 (50)*	
University	8 (14.8)*	4 (22.2)*	
Employment			
Employed	5 (9.3)*	2 (11.1)*	0.99
Unemployed	49 (90.7)*	16 (88.9)*	
Habitant			
Rural	5 (9.3)*	4 (22.2)*	0.15
Urban	49 (90.7)*	14 (77.8)*	
Catheter duration			
Month	33.2±20.8 [#]	44.8±21.1 [#]	0.046
Dialysis duration			
Month	33.3±20.9 [#]	42.9±21.9 [#]	0.07
Cause of renal failure			
DM	27 (50)*	9 (50)*	0.53
HTN	12 (22.2)*	6 (3.33)*	
Other	15 (27.8)*	3 (16.7)*	
Visual state			
Good	25 (46.3)*	10 (55.6)*	0.5
Poor	29 (53.7)*	8 (44.4)*	
Daily dialysis exchange			
Number/day	3.8±0.73 [#]	2.72±1.13 [#]	<0.001
Nasal mucosal culture			
Positive (<i>Staphylococcus aureus</i>)	3 (5.55)*	1 (5.55)*	1

[#]Mean±SD, *Number (%). SD: Standard deviation, DM: Diabetes mellitus, HTN: Hypertension

had one episode every 54 patient-months. Tunnel infection occurred just in one patient in dressing group.

With Chi-square test, patient employment, education level, place of settlement, visual ability and cause of renal failure had no effect on peritonitis and ES infection rate in all patients and in no-dressing group ($P > 0.05$). Peritonitis but not ES infection was significantly more frequent in male gender versus female in overall patients (38% vs. 14%, $P = 0.025$) and in dressing group (52% vs. 15%, $P = 0.003$), but gender had no effect in no-dressing group (0% vs. 10%, $P = 0.36$). In dressing group, peritonitis was more frequent in diabetics versus non-diabetics (48% vs. 11%, $P = 0.01$), and rural versus urban settled patients (80% vs. 24% $P = 0.023$), but visual acuity, employment and education level had no effect ($P > 0.05$). Our analysis on the basis of independent sample t -test, regardless to groups, showed that nPCR was lower in patients with ES infection than without (0.70 ± 0.18 vs. 0.81 ± 0.17 , $P = 0.049$). In dressing group patients with peritonitis

had higher LDL-C level than without (125.2 ± 62.2 vs. 94.4 ± 29.6 , $P = 0.016$). In no-dressing group patients with peritonitis had higher serum ferritin compared with dressing group (594.3 ± 0 vs. 190.4 ± 130.3 , $P = 0.008$).

According to backward likelihood rate multiple logistic regression analysis, odds ratios for developing peritonitis was 9.4 in dressing group (95% confidence interval [CI] = 1.05 – 84.4; $P = 0.045$), 4.4 in men (95% CI = 1.26 – 15.19; $P = 0.02$) were statistically significant.

Discussion

Peritonitis and ES infection are the major causes of PD technique failure, catheter-related dropout, morbidity and death in patients undergoing CAPD.^[1-4]

In order to prevent ES infection, many studies suggested application of mupirocin^[1,9,13] and gentamicin,^[1] povidone iodine,^[14] sodium fucidate,^[13] sodium hypochlorite,^[9] povidone iodine + sodium hypochlorite,^[14] ciprofloxacin otologic solution,^[11] octenidine dihydrochloride/phenoxyethanol water + non-disinfectant soap or 0.9% sodium chloride,^[14] silver ring device^[10] at ES as the chronic care, or using silver-ion implanted catheters.^[12]

In this study for determining the role of dressing with or without use of antibiotic and other disinfectant agent versus no-dressing on ES and peritonitis occurrence, we compared peritonitis and ES infection rate in two groups of CAPD patients with and without ES dressing. There was a significant higher peritonitis ($P = 0.03$) and ES infection ($P = 0.02$) in dressing group.

Bernardini *et al.*^[11] have recommended that, povidone iodine preparations and hydrogen peroxide should be avoided, especially during the early healing phase immediately following catheter implantation due to epithelial toxicity.

Kopriva–Altfahrt *et al.* in a study showed effectiveness of prophylactic mupirocin in preventing peritonitis and ES infection in *Staphylococcus aureus* carriers, so that the group with using prophylactic mupirocin had lower incidence of peritonitis (*S. aureus*: One episode/1128.2 patient-months vs. one episode/334.4 patient-months) and ES infection (*S. aureus*: 1 episode/188.0 patient-months vs. one episode/111.5 patient-months).^[14]

Cavdar and coworker in their study found that regular once weekly mupirocin application on catheter exit site in CAPD patients caused 66% mupirocin resistance, and 38.8% methicillin resistance among coagulase-negative staphylococcus isolates.^[22]

In a 5-year follow-up study, Lima *et al.* had 95 episodes of peritonitis that occurred in 54 patients (66.3%) and have reported 35.7% peritonitis episodes associated with ES infection. They supposed that this high incidence of peritonitis rate may be due to mupirocin avoidance in their center to prevent mupirocin resistant *S. aureus*.^[23]

Table 2: Comparison of laboratory data in dressing and no-dressing groups during 6 month period

Variables	Group	Months				P
		First	Second	Fourth	Sixth	
Kt/V total	Dressing	2.39±0.66	2.32±0.73	2.41±1.07	2.4±1.09	0.26
	No-dressing	2.74±1.15	2.58±1.17	2.67±1.4	2.53±1.15	
Kt/V renal	Dressing	0.89±0.77	0.94±1.48	0.88±1.05	1.01±1.13	0.043
	No-dressing	1.6±1.39	1.43±1.39	1.52±1.71	1.45±1.52	
Kt/V peritoneal	Dressing	2.18±1.5	3.12±1.1	1.58±0.58	1.52±0.43	0.25
	No-dressing	1.24±0.53	1.27±0.06	1.18±0.58	1.17±0.59	
nPCR (g/kg)	Dressing	0.78±1.19	0.73±0.02	0.78±0.24	0.81±0.28	0.29
	No-dressing	0.88±0.17	0.82±0.12	0.83±0.23	0.8±0.18	
BMI (kg/m ²)	Dressing	25.6±4.8	25.9±4.9	26.2±4.9	26±4.9	0.47
	No-dressing	24.8±4.8	24.9±4.9	25±4.9	25±4.9	
WBC (count/mm ³)	Dressing	7168±1934	6317±1495	6041±1687	6135±1658	0.024
	No-dressing	13120±10013	12937±9683	6216±1466	5942±1424	
Hemoglobin (g/dl)	Dressing	10.9±2.1	10.6±2	11.7±3.6	11.3±1.8	0.2
	No-dressing	11.9±1.9	11.8±1.7	11.7±2.3	11.5±2	
HDL-cholesterol (mg/dl)	Dressing	34.3±8.5	36.6±9.4	37.7±9.4	39.1±9.3	0.08
	No-dressing	41.5±18.9	40.5±17.9	41.7±20.6	46.5±22.8	
LDL-cholesterol (mg/dl)	Dressing	98.7±41.8	119±109.6	95.1±40.2	101.2±50.6	0.67
	No-dressing	114.5±48.5	116.5±41.5	105.3±44.7	97.5±34	
Triglyceride (mg/dl)	Dressing	178.1±48.5	181.5±203.9	160±119.7	180.3±166.8	0.39
	No-dressing	139.1±67.6	167±142	133.1±82.7	143.9±60.5	
Cholesterol (mg/dl)	Dressing	170.1±47.4	178.9±61	167.2±48.9	175.1±57.2	0.56
	No-dressing	186.3±51.2	190±60.4	173.2±48.7	171.1±32.9	
Calcium (mg/dl)	Dressing	8.38±0.82	8.64±0.64	8.64±0.95	8.57±0.97	0.7
	No-dressing	8.68±0.6	8.71±0.66	8.57±0.51	8.52±0.59	
Phosphorus (mg/dl)	Dressing	4.76±1.03	4.55±1.18	4.29±1.14	4.38±0.97	0.6
	No-dressing	4.45±0.84	4.43±0.76	4.13±0.63	4.48±0.79	
Albumin (g/dl)	Dressing	3.62±0.51	3.63±0.59	3.5±0.65	3.39±0.69	0.5
	No-dressing	3.82±0.53	3.7±0.63	3.46±0.5	3.54±0.61	
iPTH (pg/ml)	Dressing	302.3±387.8	291.2±348	306.2±338.5	319.4±388.1	0.55
	No-dressing	202.8±197	233.3±232.5	288.7±317.4	293.7±237.2	
Serum iron (µg/dl)	Dressing	60.6±24.8	60.5±23.9	62.8±28.2	67.4±43.6	0.34
	No-dressing	57.5±28.8	58±27	53.5±22.7	58.9±22.6	
Ferritin (ng/ml)	Dressing	316.4±307.7	324.5±338.5	314.5±350.3	304.3±360.3	0.2
	No-dressing	200.4±151.5	204.2±191.7	242.1±227.3	204.6±140.8	
TIBC (µg/dl)	Dressing	296.3±55	298.2±55.6	273.1±62.3	277.8±75.9	0.24
	No-dressing	322.6±77	316.8±77.1	290.2±78.3	384.3±66.9	
Fasting blood sugar (mg/dl)	Dressing	138.3±61.9	143.9±90.9	140.3±84.7	141.9±68	0.99
	No-dressing	141.3±73.1	146.3±98.4	141.4±100.7	134.1±75.6	

nPCR: Normalized protein catabolic rate, BMI: Body mass index, WBC: White blood cell, iPTH: Intact parathyroid hormone, TIBC: Total iron binding capacity, HDL: High-density lipoprotein, LDL: Low-density lipoprotein

Moreira *et al.*^[24] and Takei^[25] and Barretti *et al.*^[26] have confirmed that mupirocin, applied at nasal mucosa or exit-site as part of regular exit-site care, reduces the risk of *S. aureus* peritonitis and exit-site infection.

Piraino *et al.*^[27] have showed an overall reduction in the peritonitis rate caused by gram-negative agents from 0.52 to 0.34 episode/year with the use of topical gentamicin cream on ES. They have also reported a 63% reduction in the risk of infectious complications due to *S. aureus* because of the use of mupirocin.

In one randomized, controlled trial Zimmerman *et al.*^[28] have reported a significant decrease in ES infection incidence with administration of oral rifampin, 300 mg PO 2 times/day for the first 5 days of each 12-week interval (0.26 vs. 0.93 catheter infections per patient-year in the control group without treatment). Falagas *et al.* in a meta-analysis of four randomized studies in hemodialysis or PD patients concluded that the development of *S. aureus* resistance to rifampin ranging from 0% to 18.2% of patients who treated with oral rifampin.^[29]

Following studies showed that using these measures in contrast, caused atypical bacterial infection with drug

Table 3: Comparison of exit site and peritonitis infection rates in dressing and no-dressing group and their causative agent

Group infection	Exit site infection	Peritonitis	Peritonitis culture result n (%)					Tunnel infection	
			Negative	<i>Streptococcus viridance</i>	<i>Escherichia coli</i>	<i>Klebsiella</i>	<i>Enterococcus</i>		<i>Staphylococcus epidermidis</i>
Dressing									
Patient	12	14	6 (31.6%)	2 (10.5%)	1 (5.3%)	1 (5.3%)	1 (5.3%)	8 (42.1%)	1
Episode	17	19							
No-dressing									
Patient	0	1	1 (50%)	0	0	1 (50%)	0	0	0
Episode	0	2							
Total									
Patient	12	15	7 (33.3%)	2 (9.5%)	1 (4.76%)	2 (9.5%)	1 (4.76%)	8 (38%)	1
Episode	17	21							
<i>P</i>	0.02	0.03							

resistant micro-organisms,^[15-20] which may increase morbidity and infection-related complications.

In accord with the International Society For Peritoneal Dialysis (ISPD) guidelines, each PD center's peritonitis rate should not be more than one episode every 18 months (0.67/year at risk),^[6] in our study overall rate was one episode every 20.6 patient-months but was significantly more favorable in our no-dressing group versus dressing group (one episode every 54 patients-months vs. one episode every 17.1 patients-months respectively).

Fernandes *et al.*, in a large national multicenter study (Brazilian Peritoneal Dialysis Multicenter Study),^[30] have reported an overall peritonitis rate of one episode every 30 months with a mean follow-up of 13.6 months (most frequently due to *S. aureus*), while Moraes *et al.*, in a single center study^[31] have reported one episode every 14.63 months when describing 25-year cumulative data in Brazil.

In our study, we found *Staphylococcus epidermidis* as the most common cause of peritonitis.

In Lobo *et al.* study,^[32] *S. aureus* was the most frequent isolated microorganism (27.8%) in peritonitis cases. Furthermore, Moraes *et al.* and Caramori^[31,33] have reported *S. aureus* as the major etiologic agent in peritonitis patients. However, Barretti *et al.*^[26] and Kavanagh *et al.*^[34] have reported *Escherichia coli* as the most common cause of peritonitis.

In our study, there was 33.33% culture negative peritonitis, a value greater than that recommended in the ISPD guidelines (<20%).^[6] Lima *et al.*^[23] and Moraes *et al.*^[31] have reported culture negative peritonitis similar to our study (33.7% and 26% respectively).

In our study, as shown in Table 3, ES infection was significantly more common in dressing compared with no-dressing patients group. Alves *et al.*^[35] reported that catheter-related infections were more frequent in warmer

months. Furthermore, Stinghen *et al.*^[36] believe that maintaining the catheter and ES orifice drier can help reduce the incidence of infections in tropical countries. Twardowski and Prowant suggested healthy ESs usually do not get infected unless traumatized and hence they did not recommend prophylactic antibiotics for good or perfect ESs unless when it was accidentally traumatized. So they considered antimicrobial agent usage as a treatment but not prophylaxis in these cases.^[37]

Naylor and Roe^[38] in a pilot randomized controlled trial, 13 patients were allocated to a control group ($n = 10$), which used a routine cleaning procedure with a dressing over the exit-site. Another group ($n = 3$) used the same procedure but left the ES open. There was no significant difference in the number of infections as identified by positive culture growth ($P = 1.0$).

Much controversy exists about if any dressing and type of that should be applied in chronic PD patients.^[39,40] One study,^[14] reported that although the patients were offered no-dressing for their chronic ES care, only a few patients did not use a dressing at their ES due to unsafe feeling without dressing.

Two studies in chronic exit-site care in adults did not show any difference in the incidence of exit infection between groups with and without dressing.^[39,41]

Although Gokal *et al.* indicated that they could not document lower infection rates in adults, dressings for chronic care was used according to anecdotal experience or individual preference. Dressing was used to keep the ES clean, protect it from trauma, and stabilize the catheter.^[42] Our study is in favor to remove dressing in the case when we have perfect or good ES and dressing only to be used for all patients when the ES is infected or likely to become grossly contaminated.

In an international survey for PD catheter ES care, Prowant *et al.* reported that only 31% of US adult and 44% of pediatric centers required patients to wear

dressings in comparison with >60% of Canadian and European centers and by 50% of PD programs in other countries. In this study, the authors found that many of the centers suggested that the patients should be allowed to choose wearing or not a dressing over the ES according their preference.^[43]

While in a retrospective analysis in children, Watson *et al.*^[44] found significantly fewer infections in catheters covered with occlusive dressings; our study showed ES dressing omission would reduce its infection. It may be due to less humidity and maceration and better evaporation so that put the ES in less favorable environment for bacterial growth. Furthermore, there are some units that prefer do not using any dressing 6 months post PD catheter implantation if the ES is well-healed.^[45]

Lower nPCR was observed in patients with ES infection but not with peritonitis. To prove that poor nutritional status can cause higher ES infection, more detailed study should be conducted.

Conclusion

According to this study, chronic ES care without dressing was associated with lower risk of peritonitis and ES infection. Our study was a retrospective observational assessment, and our results need to be confirmed by prospective randomized studies with more sample size to suggest newer strategies for better patient ES care.

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Conflicts of interest

There are no conflicts of interest.

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