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Original Article

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Impact of the Anatomical Localization of the Exit Site on Complications in Patients on Peritoneal Dialysis

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ABSTRACT

Background: Infections are the most common complications in patients with peritoneal dialysis (PD). The association between the anatomical localization of the exit site (ES) and infectious complications is unclear. In this study, we evaluated the relationship between the anatomic location of the ES and infectious complications of PD.

Methods: We examined the ES of 53 patients on PD. To define the anatomical localization of the ES, its distance from the line between right and left anterior superior iliac spines (A line), umbilicus (B line), and the anterior superior iliac spine on the catheter side (C line) was measured.

Results: Coiled catheters were used in all patients. The mean lengths of A line, B line, and C line were 4.1 ± 2.2 cm (range, 0-9.5 cm), 9.6 ± 2.9 cm (range, 4-17 cm), and 9.3 ± 2.9 cm (range, 5-18 cm), respectively. ES infection was documented in 9 patients (17%), tunnel infection in 1 patient (2%), and peritonitis in 27 (50.9%) patients. The B line was significantly longer in those with peritonitis than those without peritonitis (10.6 ± 3 vs. 8.7 ± 2.7 cm; $P = .036$). Other variables were not associated with infectious complications.

Conclusion: There was an association between the anatomical localization of the ES and the development of peritonitis. An ES close to the umbilicus could reduce the risk of peritonitis by enabling access by the patient to perform daily care.

Keywords: Exit-site, peritonitis, peritoneal dialysis

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INTRODUCTION

Long-term functional peritoneal access is a prerequisite for successful peritoneal dialysis (PD) as renal replacement therapy. At first glance, the placement of a rubber tube through the abdominal wall into the peritoneal cavity seems simple, but caution is required to prevent catheter dysfunction and/or infection.

PD catheter-related infections are a major predisposing factor to PD-related peritonitis, result in considerable morbidity, and have a mortality rate of 3.5-10.0%.[1] Most recommendations on PD catheters have been primarily focused on preventing and treating catheter-related infections. The basic recommendations on the insertion technique of the peritoneal catheter are that the catheter should pass through the subcutaneous tunnel as it reaches the abdomen, and the exit site should face downwards and laterally.[2] Another study indicated that the ES should be at least 2 cm from the external superficial cuff.[3] These results revealed that the location of the ES is important, as it is related to the risk of infectious complications.

The association between the anatomical localization of the ES and infectious complications is unclear. The location of the catheter and the localization of the ES are generally decided by the preference of the patient and the operator based on predetermined landmarks. In this

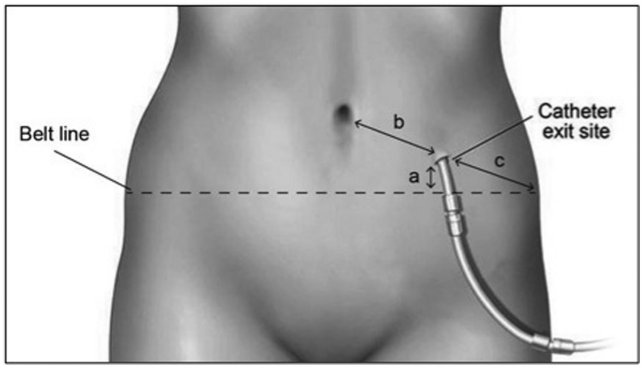

Figure 1. Demostration of the measurements for the exit-site location (a: Distance to the line between right and left anterior superior iliac spines, b: Distance to umbilicus, c: Distance to the anterior superior iliac spine).

study, it is aimed to determine the optimal location for the ES with the lowest risk of infectious complications by anthropometric measurements.

MATERIALS AND METHODS

We examined the ES's of the patients on PD from the PD Clinic of Marmara University Pendik Training and Research Hospital. To define the anatomical localization of the ES, the distances between the ES and the line between right and left anterior superior iliac spines (A line), umbilicus (B line), and the anterior superior iliac spine on the catheter side (C line) were measured (Figure 1). If the B line was shorter than the C line, the ES localization was classified as near umbilicus. All measurements were performed by a nephrologist during a routine PD visit. ES care was performed by the patients according to a standard protocol. ES infection was diagnosed if redness and a purulent discharge were present. A tunnel infection was defined as the presence of erythema, edema, or tenderness over the subcutaneous segment of the catheter. Peritonitis was defined as cloudy dialysate with 100 white blood cells/μL, 50% or more of which were polymorphonuclear leukocytes.[4] The occurrences of ES infection, tunnel infection, and peritonitis were recorded. The association between the anatomical localization of the ES and infection was analyzed.

The data were analyzed using Statistical Package for the Social Sciences (SPSS) version 20.0 (IBM SPSS Corp.; Armonk, NY, USA). Mean ± standard deviation and median (minimum-maximum) values were used for variables as appropriate. Kolmogorov–Smirnov statistical test was used to measure distribution. The Fisher exact test was used to compare nominal data and the *t*-test to compare continuous data. A univariate analysis was first performed to identify potential predictor variables. Variables with a *P*-value <.2 according to a univariate analysis were included in the multivariate analysis to determine independent predictors of infectious complications. Statistical significance was accepted at $P < .05$.

Table 1. Demographic and Clinical Data of Study Patients

	n = 53
Age (year)	50.1 ± 13.4
Sex (Female) (%)	26 (50.9%)
BMI (kg/m^2)	26.1 ± 6.1
Primer kidney disease	
Glomerulonephritis (GN)	13 (24.5%)
Secondary Amyloidosis	5 (9.4%)
Polycystic kidney disease (PKD)	6 (11.3%)
Others	11 (20.7%)
Unknown	18 (34%)
Presence of Diabetes	4 (7.5%)
PD duration (median), days	1634
Previous hemodialysis (n, %)	9 (17%)
Automated peritoneal dialysis	12 (22.6%)

BMI, body mass index; GN, glomerulonephritis; PKD, polycystic kidney disease; PD, peritoneal dialysis.

RESULTS

This study enrolled 53 PD patients with a mean age of 50.1 ± 13.4 years; 50.9% were women ($n = 26$). The patients were followed for a median of 1634 days (range, 340-6282 days). Coiled-tip Tenckhoff double-cuff catheters were used in all patients and were inserted by nephrologists percutaneously in 34 (64.2%) patients and surgically in 19 patients (35.8%). In 43 patients (81.1%), the catheter ES was placed on the left side of the abdomen and in 10 patients (18.9%) on the right side. The mean body mass index was 26.1 ± 6.1 kg/m^2 (range, 16.7-46.9 kg/m^2). The mean lengths of A line, B line, and C line were 4.1 ± 2.2 cm (range, 0-9.5 cm), 9.6 ± 2.9 cm (range, 4-17 cm), and 9.3 ± 2.9 cm (range, 5-18 cm), respectively. Twenty-three (43.4%) patients had a near-umbilicus ES. The demographic and clinical parameters of the patients are listed in Table 1.

An ES infection was documented in 9 patients (17%), tunnel infection in 1 patient (1.8%), and peritonitis in 27 patients (50.9%). The anatomic localization of the ES was not different between patients with and without ES infection or tunnel infection (A line, 4 ± 2.3 vs. 5 ± 2.1 cm, $P = .169$; B line, 9.5 ± 3 vs. 10.2 ± 2.7 cm, $P = .404$; C line, 9.4 ± 3 vs. 8.8 ± 2.7 cm, $P = .840$). However, the B line was significantly greater in patients with peritonitis than in those without peritonitis (10.6 ± 3 vs. 8.7 ± 2.7 cm, $P = .036$). The C line was also greater in patients without peritonitis but did not reach statistical significance. The other parameters were not associated with catheter related infectious complications (Table 2). In a multivariate analysis, a near-umbilicus ES was associated with a lower risk of peritonitis (hazard ratio, 4.26; 95% CI, 1.25-14.52; $P = .021$) (Table 3).

Table 2. Univariate Analysis of Variables Associated with Peritonitis

	Peritonitis (+), $n = 27$	Peritonitis (–), $n = 26$	*P*
Age (years)	53.2 ± 12.9	47 ± 13.5	.095
Sex (F/M)	15/12	11/15	1.000
BMI (kg/m^2)	27.4 ± 7.1	24.8 ± 4.7	.119
BSA	1.78 ± 0.18	1.77 ± 0.24	.788
Right/left	5/22	5/21	.725
Insertion technique (percutaneous/surgical)	9/18	10/16	.779
Laterally/downward	25/2	22/4	.349
Distance to the line between right and left anterior superior iliac spines (distance A)	4.1 ± 2.3	4.2 ± 2.2	.987
Distance to umbilicus (distance B)	10.6 ± 3.0	8.7 ± 2.7	**.036**
Distance to the anterior superior iliac spine (distance C)	8.8 ± 2.7	9.8 ± 3.1	.203
Near umbilicus	5 (18.5%)	14 (53.8%)	**.009**

BMI, body mass index; BSA, body surface area.
Bold indicates statistically significant findings ($P < .05$).

DISCUSSION

The data on the preferred anatomical location of the ES on the abdomen are sparse. The variation in body surface area, the distance between the external superficial cuff and ES, and the angle between the internal and external cuffs of PD catheters necessitate the use of different ES locations in patients with PD. Moreover, some studies lead to a contradiction about the accuracy of basic applications. For example, it has been recommended that the ES not be on the beltline, but Piraino et al.[5] showed that an ES on the beltline did not influence the rate of catheter infection in patients with PD.

This is a single-center cohort study comparing the association between the anatomical localization of the ES and infectious complications in PD patients. In the present study, to define the anatomical localization of the ES, its distance from the line between right and left anterior superior iliac spines, umbilicus, and the anterior superior iliac spine on the catheter side was measured. We found that ES close to the umbilicus was associated with a lower risk of peritonitis.

There may be 2 basic explanations for this result. First, our findings indicate that an ES distal from the groin reduces the risk of peritonitis. An ES in an area heavily colonized by microorganisms or that may hamper the performance of daily care by the patient could increase the susceptibility to infection, particularly of the ES and catheter tunnel. Aktaş et al.[6] reported an association between *Staphylococcus aureus* carriage and *S. aureus* infection in patients undergoing PD. Indeed, following the nose, the rectal and groin areas are the most frequent sites of colonization by community-associated methicillin-resistant Staphylococcus aureus.[7] Therefore, we argue that an ES distal from the groin reduces the risk of infection.

Table 3. Multivariate Analysis of Variables Associated with Peritonitis

		95% CI		
	Odds ratio	Lower	Upper	*P*
Near umbilicus	4.258	1.249	14.518	.021
BMI (kg/m^2)	1.073	0.959	1.202	.22
Age (years)	1.019	0.972	1.068	.443

BMI, body mass index.

Second, in terms of patient comfort and accessibility, basic studies suggest that the ES must be visible to the patient and not be vulnerable to irritation by the beltline, skin creases, and mobile skin folds.[8-10] Because of these the ES location is determined with the patient in standing and sitting positions. The fact that the ES was close to the umbilicus may be related to increased visibility and accessibility of the ES by the patient, facilitating daily care, or to reduced direct trauma to the ES by avoiding from the upper and lower belt lines.

This study has several important limitations. The number of subjects was small and, also, the study was retrospective, and the patients included were from a single institution. However, to the best of our knowledge, there was no study comparing the association between the anatomical localization of the ES according to anthropometric measurements and infectious complications in PD patients.

In conclusion, our findings emphasize the need for a more scientific approach to ES localization. Selection of the optimal ES location could reduce the rate of ES infections and peritonitis, prolonging patient survival. Appropriate preoperative evaluation and selection of the optimal ES location according

to anthropometric measurements may replace conventional methods of determining the ES location.

Ethics Committee Approval: Ethics committee approval was received from the Marmara University (4/9/2020-1010).

Informed Consent: Written informed consent was obtained from all participants who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – A.V., M.T., Ç.Ö.; Design- A.V., M.T., Ç.Ö.; Supervision- A.V., M.T., Ç.Ö.; Resources – E.A., H.A., S.T.; Data Collection and/or Processing - M.T., E.A., H.A.; Analysis and/or Interpretation - H.A., A.V., M.T.; Literature Search - S.T., M.T.; Writing Manuscript - A.V., M.T.; Critical Review - E.A., H.A., S.T.

Conflict of Interest: The authors have no conflicts of interest to declare.

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