RESEARCH ARTICLE

CYPRUS
JOURNAL OF MEDICAL SCIENCES

DOI: 10.4274/cjms.2023.2023-28
Cyprus J Med Sci 2023;8(5):334-338

Comparative Analysis of the Association Between Laparoscopic Peritoneal Dialysis Catheter Placement Methods and Anterior Abdominal Wall Complications

Necmi Bayraktar

Clinic of Urology, Dr. Burhan Nalbantoğlu State Hospital, Nicosia, North Cyprus

Abstract

BACKGROUND/AIMS: Peritoneal dialysis is a cost-effective treatment method which provides a high quality of life for patients. While laparoscopic peritoneal dialysis catheter placement is generally effective and safe, procedural complications can sometimes lead to therapy interruptions or modifications. This retrospective study aimed to investigate mechanical complications of the anterior abdominal wall associated with different laparoscopic approaches.

MATERIALS AND METHODS: We conducted a retrospective analysis of peritoneal dialysis patients who underwent laparoscopic catheter insertion between 2010 and 2023. The laparoscopic techniques were categorized into three groups, and their relationships with descriptive dependent and independent variables were examined. Additionally, comparisons were made between the different groups.

RESULTS: The complication rates of the anterior abdominal wall were found to be higher with the standard laparoscopic method. We concluded that age and body mass index (BMI) are influential factors for exit site leakage (ESL). Furthermore, being older than 50 years of age was found to be a contributing factor in hernia formation.

CONCLUSION: Our findings indicate that age, BMI, and surgical method are factors which contribute to the occurrence of anterior abdominal wall complications in peritoneal dialysis. The use of a minimally traumatic trocar in the percutaneous method shows promise in preventing hernia formation, while the utilization of a paramedian entry appears advantageous in preventing ESL. Nevertheless, comprehensive and multicentric studies are needed in order to determine the most appropriate patient-specific method.

Keywords: Abdominal wall complication, exit site leakage, laparoscopic catheter insertion, peritoneal dialysis

INTRODUCTION

Peritoneal dialysis is considered one of the most effective and reliable methods for renal replacement therapy. It offers a higher quality of life and is cost-effective compared to hemodialysis. Peritoneal dialysis patients do not experience the drawbacks associated with hemodialysis, such as adverse effects and prolonged hospital stays. However, mechanical dysfunctions relating to catheters in peritoneal dialysis patients can sometimes necessitate a change in treatment. Complications associated with catheter insertion can be categorized as either infectious or non-infectious (Table 1). One surgical complication which may arise following catheter placement is trocar-related hernia. Studies have revealed that 10-20% of peritoneal dialysis patients develop herniation during the course of their treatment.

Catheter entry site herniation and abdominal wall leaks, which involve the leakage of dialysate, are the most commonly observed mechanical complications, often associated with increased intra-abdominal pressure.[1] Exit site leakage (ESL) occurs when there is a disruption in the

To cite this article: Bayraktar N. Comparative Analysis of the Association Between Laparoscopic Peritoneal Dialysis Catheter Placement Methods and Anterior Abdominal Wall Complications. Cyprus J Med Sci 2023;8(5):334-338

ORCID IDs of the authors: N.B. 0000-0001-6449-9216.

Address for Correspondence: Necmi Bayraktar
E-mail: necmi.bayraktar@neu.edu.tr
ORCID ID: orcid.org/0000-0001-6449-9216

Received: 01.04.2023
Accepted: 06.07.2023

Table 1. Peritoneal dialysis catheter complications are summarized	
The infectious and mechanic complications of PD catheter insertion	
Infectious complications	Mechanic complications
Peritonitis	Malfunction of the catheters
Catheter exit site infections	Intestinal obstruction/perforation
Tunnel infections	Leakage of the dialysate*
	Hernia
*Exit site leakage.	

integrity of the peritoneal membrane. Factors contributing to leakage include the technique used for PD catheter insertion and weaknesses in the abdominal wall.[2] Since the first laparoscopic PD catheter placement was introduced in 1990, various surgical approaches and modifications have been implemented.[3] Over time, extensive studies have led to the development of international guidelines. However, it is important to note that some advanced techniques may require more complex surgeries and surgical expertise. The primary goal of these studies is to prevent complications arising from PD catheter placement and to enable longer-term peritoneal dialysis treatment.

Peritoneal dialysis has been widely practiced in North Cyprus for over 20 years, utilizing open, laparoscopic, and percutaneous techniques for catheter placement. Each technique has its own advantages and disadvantages, and they are evaluated independently and comparatively in order to enhance their effectiveness and reliability. Various precautions and recommendations have been proposed to prevent mechanical complications of the anterior abdominal wall, specifically trocar hernia (incisional) and exit site leaks. The primary cause of hernia formation in peritoneal dialysis patients is elevated intra-abdominal pressure, which leads to trocar (optical or working) and hernia formation at the entry point. Moreover, increased intra-abdominal pressure can also result in the development of inguinal or umbilical hernias.

Our retrospective study aimed to compare the outcomes of our modified laparoscopic techniques with the standard laparoscopic peritoneal dialysis catheter placement methods regarding anterior abdominal wall complications. Our objective was to evaluate and share the results of our experience.

MATERIALS AND METHODS

Study Design

We conducted a retrospective analysis of peritoneal dialysis patients who underwent laparoscopic peritoneal dialysis catheter insertion between 2010 and 2023. This study compared standard laparoscopic peritoneal dialysis catheter placements with modified techniques regarding anterior abdominal wall complications, specifically focusing on entry site hernia and ESL.

Inclusion and Exclusion Criteria

This study included patients between the ages of 18 and 80 who were deemed eligible for peritoneal dialysis and who underwent laparoscopic peritoneal dialysis catheter placement. Individuals with a history of hernia and previous extensive abdominal surgeries were excluded from this study. Furthermore, cases which necessitated advanced laparoscopic techniques, including omentectomy, omental fixation, catheter fixation, and adhesiolysis, were also excluded.

Sample Size and Sampling Technique

The patients were divided into three groups for evaluation: Group A consisted of patients before 2018 who had midline entry sites, group B consisted of patients after 2018 who had paramedian entry sites, and group C consisted of patients before 2018 who underwent the standard laparoscopic peritoneal dialysis catheter placement method.

In group A, the laparoscopic peritoneal dialysis procedure was combined with the percutaneous technique. Instead of using a trocar or another instrument, a pull-apart dilator was employed to create a tunnel in the rectus fascia, with only a skin incision made from the midline. Direct vision was facilitated using a 5 mm laparoscope.

In group B, the laparoscopic peritoneal dialysis procedure was combined with the percutaneous technique. However, unlike group A, the tunnel in the rectus fascia was created in the paramedian area instead of the midline.

In group C, the standard laparoscopic peritoneal dialysis catheter placement method was utilized.

Patients were provided with informed consent forms before the surgery in order to ensure understanding and agreement. Ethical approval for this study was obtained from the Ethics Committee of the TRNC Ministry of Health (approval number: YTK.1.01-EK25/22).

Statistical Analysis

Descriptive and characteristic features were analyzed using crosstabs, and the results of qualitative data are presented in terms of incidences and percentages [(n) and (%), respectively]. The independent variables included in the model were age, body mass index (BMI), operation time, hernia formation, and ESL. The association between the dependent and independent variables was determined using levels of significance and confidence intervals (CIs). Non-parametric tests were employed due to the non-homogeneous distribution of the data. The Independent-Samples Kruskal-Wallis test was utilized to compare differences between groups. Factors influencing any events were assessed using the Cox regression test. Statistical analysis of the obtained data was performed using the SPSS Windows version 24.0 statistical package program.

RESULTS

A total of 65 patients were included in this study. The mean age of the patients included in this study was 59.78 years (range: 18-80). Of the patients, 52 (80%) were male, and 13 (20%) were female. The mean operative time was 26 minute (range: 14-95). Group A comprised 22 patients, group B had 16 patients, and group C consisted of 27 patients. Twelve patients had a hernia at the catheter insertion site, with nine experiencing ESL complications. Age, gender, BMI, operation time, the presence of hernia, and ESL data are summarized according to the groups in Table 2.

In order to compare the occurrence of catheter insertion hernia formation between the groups, a non-parametric independent samples Kruskal-Wallis test was conducted. A p-value less than 0.05 was considered statistically significant. There was no difference between groups A and B, but a statistically significant difference was observed between group C and the other 2 groups (Table 3A, B).

Comparisons between the groups regarding ESL were made using the non-parametric independent samples Kruskal-Wallis test. A difference was found between groups B and C, but there was no significant difference between groups A and B or between groups A and C (Table 4A, B).

Cox regression analysis was performed in order to examine the relationship between various factors and the occurrence of hernia formation. The analysis revealed no statistically significant relationship between gender and hernia formation (p=0.79). Furthermore, no significant relationships were found between operation time (p=0.11) or BMI (p=0.84) and hernia formation. However, a statistically significant association was observed between age and hernia formation (p=0.01, 95% CI: 1.023-1.183).

In the Cox regression analysis for the occurrence of ESL, no statistically significant correlations were found between gender and ESL (p=0.83) or between BMI and ESL (p=0.057) (95% CI). However, age (p=0.02, 95% CI: 1.004-1.052) and operative time (p=0.07, 95% CI: 0.970-0.995) showed a statistical significance in relation to ESL.

DISCUSSION

Anterior abdominal wall complications are common in patients undergoing peritoneal dialysis.[4] Various factors contribute to the occurrence of these complications, including the surgical technique used, age, BMI, duration of surgery, time to start dialysis, presence of accompanying risk factors such as diabetes, and the causes of the chronic kidney disease. These complications can lead to treatment interruptions or even necessitate a switch in treatment modality.[4]

The peritoneal dialysis catheter is typically inserted into the peritoneal cavity using either a surgical technique (open surgery or laparoscopic-assisted) or a percutaneous technique (Seldinger or modified Seldinger techniques), with or without fluoroscopic guidance.[5] In laparoscopic procedures, placing the catheter by creating a rectus sheath tunnel helps prevent complications such as catheter migration and early leakage.

Cabtree and Fishman[6] provided a detailed description of creating a tunnel in the preperitoneal area. Rectus sheath tunneling (RST) has been shown to reduce hernia formation and ESL.[7] The standard laparoscopic method typically uses instruments such as a laparoscopic grasper or a 5 mm trocar to create the tunnel. Our modified approach uses a smaller and less traumatic pull-apart sheath/dilator. The smaller

Table 2. Descriptive statistics for study variables

		Group A		Group B		Group C	
		Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)
Age		55.27±14.26		62.75±9.92		61.70±10.58	
Sex	Male		16 (72.7%)		13 (81.3%)		23 (85.2%)
	Female		6 (27.3%)		3 (18.8%)		4 (14.8%)
BMI (kg/m²)		29.16±4.75		26.12±4.53		27.44±4.21	
Operation time (min)		23.32±13.16		25.63±18.79		65.07±12.56	
Hernia	Yes		2 (9.1%)		1 (6.3%)		9 (33.3%)
	No		20 (90.9%)		15 (93.8%)		18 (66.7%)
	Total		22 (100.0%)		16 (100.0%)		27 (100%)
ESL	No		20 (90.9%)		16 (100.0%)		20 (74.1%)
	Yes		2 (9.1%)		0 (0.0%)		7 (25.9%)
	Total		22 (100.0%)		16 (100.0%)		27 (100%)

The study variables are shown as mean, standard deviation, and percentage. BMI: Body mass index, ESL: Exit site leakage, SD: Standard deviation.

Table 3A. Statistical comparison of the three groups in terms of hernia formation

Independent samples Kruskal-Wallis test summary	
Total, (n)	65
Test statistic	6.730
Asymptotic sig. (2-sided test)	**0.035***

*Bold and underlined numbers indicate statistical differences between groups.

Table 3B. Pairwise comparisons of groups in terms of hernia formation

Sample 1-sample 2	Test statistic	Standard error	Standard test statistic	Sig.
Group C-group A	7.879	3.650	2.159	**0.031***
Group C-group B	8.802	4.009	2.195	**0.028***
Group A-group B	-0.923	4.175	-0.221	0.825

Asymptotic significances (2-sided tests) are displayed. The significance level is 0.05.
*Bold and underlined numbers indicate statistical differences between groups.

Table 4A. Statistical comparison of the three groups in terms of exit site leakage

Independent samples Kruskal-Wallis test summary	
Total, (n)	65
Test statistic	6.194
Asymptotic sig. (2-sided test)	**0.045***

*Bold and underlined numbers indicate statistical differences between groups.

Table 4B. Pairwise comparisons of groups in terms of exit site leakage

Sample 1-sample 2	Test statistic	Standard error	Standard test statistic	Sig.
Group B-group A	2.955	3.717	0.795	0.427
Group B-group C	-8.426	3.569	-2.361	**0.018***
Group A-group C	-5.471	3.249	-1.684	0.092

-Asymptotic significances (2-sided tests) are displayed. The significance level is 0.05.
*Bold and underlined numbers indicate statistical differences between groups.

diameter of the pull-apart sheath/dilator used in our modified method may contribute to a lower incidence of hernia formation than the standard laparoscopic method. Additionally, the RST created in the modified method is shorter than in the standard method, reducing surgical trauma and defects during tunnel creation in the preperitoneal space and peritoneal entry site. Blitzkow et al.[8] used a similar pull-apart sheath/dilator in their modified method and reported similarly low rates of hernia formation.

Studies investigating the risk factors for hernia development provide conflicting information regarding gender and age. Some studies suggest that hernia is more common in older individuals (>40 years) or men, while others report no significant association between age, gender, and hernia formation.[4] Small body size and low weight (<60 kg) have been identified as risk factors for hernia development in some studies. However, in our study, we did not find a significant difference in terms of gender and BMI between those patients with and those without hernia. Nevertheless, we did observe that older age (over 50) was a risk factor for hernia formation.[9] Midline injury and hernia formation occur due to the weak support tissue of the midline, and paramedian access is often recommended. However, our study did not find any difference in hernia formation between midline and paramedian entrances. This may be attributed to using a low-diameter, bladeless trocar (pull-apart sheath/dilator) and the support provided by the distal cuff of the peritoneal catheter at the midline defect. In fact, our study and others have shown that surgical technique, in addition to other factors, plays a significant role in preventing or causing complications.[10] Complications are observed at higher rates in patients with compromised peritoneal integrity and in those who undergo multiple surgical procedures.[3,11]

The modified methods demonstrated lower rates of ESL compared to the standard method. This can be attributed to the use of a low-diameter and flexible trocar, as well as the creation of an exit area in compliance with international guidelines. The reduced ESL rates may be due to the ability to perform manipulations using a single trocar, which lowers the risk of leakage and infection compared to the standard technique involving multiple trocar entries. However, it should be noted that leakage is more commonly observed at midline entrances, highlighting the significance of surgical procedures and instrumentation. The results are influenced not only by changes in surgical technique, but also by the surgeon's experience, skill, and advancements in minimally invasive treatments.[6,10]

Study Limitations

One weakness of our study was the lack of homogeneous distribution and the absence of a randomized controlled evaluation of the patients. It is evident that assessing numerous variables in a small sample can result in statistically biased outcomes. Another limitation of this study was the restricted number of variables considered. Also, it should be noted that changes in surgical technique over time and the surgeon's increased experience could influence the results. While including North Cyprus data may introduce bias regarding changes in surgical technique and experience, the comparisons made between the groups and the identification of common factors affecting the outcomes helped mitigate this bias.

CONCLUSION

Our study found that the surgical technique plays a crucial role in the occurrence of anterior abdominal wall complications. Using atraumatic trocars in the percutaneous method, regardless of the point of entry into the rectus fascia, appears advantageous in preventing hernias. Paramedian abdominal access also seems beneficial in preventing ESL, regardless of the type of trocar used. However, it is important to note that complications in peritoneal dialysis are influenced by various factors beyond surgical technique. In conclusion, further multicenter controlled studies and standardization efforts are needed in order to obtain more specific findings and establish patient-specific treatment guidelines, particularly regarding surgical procedures.

MAIN POINTS

- Comparative analysis of the association between laparoscopic peritoneal dialysis catheter placement methods and anterior abdominal wall complications.
- Mechanical complications between minimally invasive peritoneal catheter insertion techniques.
- Impact of surgical modifications and experience on treatment outcomes.
- Complications associated with laparoscopic peritoneal dialysis catheter insertion.

ETHICS

Ethics Committee Approval: Ethical approval for this study was obtained from the Ethics Committee of the TRNC Ministry of Health (approval number: YTK.1.01-EK25/22).

Informed Consent: Patients were provided with informed consent forms before the surgery in order to ensure understanding and agreement.

Peer-review: Externally and internally peer-reviewed.

DISCLOSURES

Financial Disclosure: The author declared that this study received no financial support

REFERENCES

1. Flayou K, Ouzeddoun N, Bayahia R, Rhou H, Benamar L. Mechanical complications of continuous ambulatory peritoneal dialysis: Experience at the Ibn Sina University Hospital. Saudi J Kidney Dis Transpl. 2016; 27(1): 107-10.
2. Leblanc M, Ouimet D, Pichette V. Dialysate leaks in peritoneal dialysis. Semin Dial. 2001; 14(1): 50-4.
3. Haggerty S, Roth S, Walsh D, Stefanidis D, Price R, Fanelli RD, et al. Guidelines for laparoscopic peritoneal dialysis access surgery. Surg Endosc. 2014; 28(11): 3016-45.
4. Del Peso G, Bajo MA, Costero O, Hevia C, Gil F, Díaz C, et al. Risk factors for abdominal wall complications in peritoneal dialysis patients. Perit Dial Int. 2003; 23(3): 249-54.
5. Keshvari A, Keramati MR, Nassajian MR, Mohsenipour M, Nouritaromlou MK. Introduction of a new laparoscopic trocar for insertion of peritoneal dialysis catheters and making a proper rectus sheath tunneling. Surg Endosc. 2016; 30(12): 5325-9.
6. Crabtree JH, Fishman A. A laparoscopic method for optimal peritoneal dialysis access. Am Surg. 2005; 71(2): 135-43.
7. Bircan HY, Kulah E. Effects of a Novel Peritoneal Dialysis: The Open Versus Laparoscopic Preperitoneal Tunneling Technique. Ther Apher Dial. 2016; 20(1): 66-72.

8. Blitzkow ACB, Biagini G, Sabbag CA, Buffara-Junior VA. Laparoscopic Peritoneal Dialysis Catheter Placement with Rectus Sheath Tunneling: A One-Port Simplified Technique. Arq Bras Cir Dig. 2022; 35: e1690.

9. García-Ureña MA, Rodríguez CR, Vega Ruiz V, Carnero Hernández FJ, Fernández-Ruiz E, Vazquez Gallego JM, et al. Prevalence and management of hernias in peritoneal dialysis patients. Perit Dial Int. 2006; 26(2): 198-202.

10. Crabtree JH, Shrestha BM, Chow KM, Figueiredo AE, Povlsen JV, Wilkie M, et al. Creating and Maintaining Optimal Peritoneal Dialysis Access in the Adult Patient: 2019 Update. Perit Dial Int. 2019; 39(5): 414-36.

11. Htay H, Johnson DW, Craig JC, Schena FP, Strippoli GF, Tong A, et al. Catheter type, placement and insertion techniques for preventing catheter-related infections in chronic peritoneal dialysis patients. Cochrane Database Syst Rev. 2019; 5(5): CD004680.